Robert R. Marriam, Consultant
Remedium Group, Inc.
A Subsidiary of W. R. Grace & Co.

6401 Poplar Ave., Suite 301
Memphis, TN 38119

Tel: (901) 820-2023
Fax: (901) 820-2061

Remedium

April 26, 2010

Ms. Bonita Lavelle
US EPA Region 8
EPR - SR
1595 Wynkoop Street
Denver, CO 80202-1129

Dear Bonnie,

As part of the approval of the 5-Year Permit for the Kootenai Development Dam (KDID), it was required that the length and location of the terminal end of the 12 toe drains be established. Billmayer & Hafferman, Inc. (Montana Professional Engineers who are the engineers of record for this dam) have completed the investigation and have prepared the attached inspection report.

Please advise if there are any questions.

Robert R. Marriam

Cc: W. M. Corcoran (w/out attachments)
R. J. Medler (w/out attachments)

dwp
Enclosure

Billmayer & Hafferman Inc.

KOOTENTAI DEVELOPMENT IMPOUNDMENT DAM
TOE DRAIN INSPECTION REPORT

APRIL 1, 2010

Report prepared for
Remedium Group, Inc.
6401 Poplar Ave.
Memphis, TN 38119

KOOTENTAI DEVELOPMENT IMPOUNDMENT DAM
TOE DRAIN INSPECTION REPORT

BHI File No.: R.56.1

By

Kurt Hafferman, P.E.
April 1, 2010

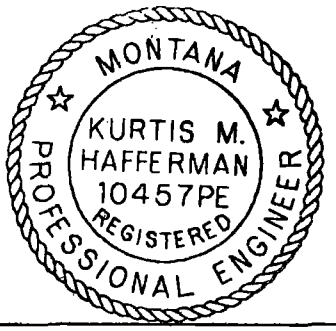
Statement of Qualification of the Professional Engineer

Kootenai Development Impoundment Dam Toe Drain Inspection Report

I declare that to the best of my professional knowledge and belief that I meet the definition and have satisfied the licensing requirements of a Licensed Professional Engineer in the State of Montana as defined in all of the Statutes and Rules applicable to the Board of Professional Engineers and Professional Land Surveyors as described in Title 37, Chapter 1, Part 3 in the Montana Code Annotated Uniform Regulatory Act passed by the Legislature in 1995 including all Administrative Rules pertaining to engineering and land surveying that are written and adopted by the Board of Professional Engineers and Professional Land Surveyors.

I declare that I have the specific qualifications based on education, training, and experience to assess a property of the nature, history, and setting of the subject property and that I have developed and performed the appropriate inquiries in conformance with the standards and practices.

I declare that I have personally performed the data collection and completed this report titled the Toe Drain Inspection Report for the Kootenai Development Impoundment Dam, know as the subject property. This assessment has revealed the conditions discussed in the attached report in connection with the property. I declare that the statements made in this report are true to the best of my belief and professional knowledge.



4-1-2010

Kurtis M. Hafferman, P.E. MT PE 10457 Date

Executive Summary

Per condition 2 of the DNRC Operational Permit for the Kootenai Development Impoundment Dam BHI conducted an investigation of the 12 toe drains at the base of the embankment in order to determine the total length and location of the terminal end of each drain. The means of inspection was to use a video camera on a push pole.

The inspection determined that the drains installed in KDID do not match the plan drawings available. The drains deviate significantly from all previous assumptions. The only drains that appear to match the plan drawings are the center drain, Drain 6, and drain 3. All other drains terminate in a gravel matrix at the toe of the dam. The drains are considered in fair to poor condition over all. Drains 9 and 12 appear to have significant cracking in the ceiling of the pipe and may have been crushed during construction or may have failed in compression in the last few years. Drain 11 is showing a significant void at the end of the pipe and there is silt, sand and rock material that is being transported out of the embankment. Drain 10 is also transporting material out of the embankment. Drain 2, in the left abutment, shows a crack in the pipe and there is a significant gravel deposit on the invert of the pipe.

Harding Lawson Associates Geotechnical Evaluation of February 1992 states that a series of 20-foot-wide 2-foot-high drainage blankets consisting of native gravel material was placed at the embankment foundation level and eight-inch-diameter perforated pipes were embedded within the drainage blankets and were connected to a single 14-inch-diameter pipe which was extended at each subsequent stage of construction and presently emerges from the downstream side. If the Harding Lawson statement were taken literally, we would not expect to see any drains on the toe other than the 14-inch steel pipe at the center of the dam. There is no information in any of the previous documents or in the previous Harding Lawson report that indicate that there is either a gravel toe berm or a concrete headwall and no other indications of gravel or rocks placed near or in the drain pipes.

Harding Lawson found that the groundwater level immediately upstream of the embankment does not rise above the foundation level yet the BHI report on the Piezometer and Toe Drain Discharge Monitoring of February 2010 found that the phreatic water surface in piezometer P2 on the upstream face of the embankment rises as much as 30 ft. to 40 ft. above the foundation level.

The data to date seems to indicate that the capacity of the drain system may have changed since the 1992 Harding Lawson evaluations and It is possible that the pipes in the drain system have collapsed.

It is recommended that five exploratory projects be conducted to further understand the condition of the drains system. The project will be to determine if drain 3 terminates in a perforated cross drain that all other drains originally connected to but have since collapsed, if there is a gravel toe berm near drain 11, if there is a cross drain connected to drain 6 that is either collecting or conducting water, and if the surface water near piezometer A8 is emerging up from the foundation or moving laterally through the embankment.

TABLE OF CONTENTS

LIST OF FIGURES

Introduction

On Monday March 1st , Tuesday March 2nd, and Wednesday March 3rd a video camera inspection of nine (9) of the twelve (12) toe drains on the Kootenai Development Impoundment Dam (KDID) was conducted by Billmayer & Hafferman Inc. (BHI). The inspection was conducted to meet the requirements of the DNRC Water Resources Division, Dam Safety Operational Permit, Condition 2, which required that the exact location of the terminal end (the furthest upstream end) of each of the drains needs to be mapped.

The plan to map the terminal end of each drain was to attach a video camera to a sled and attach the sled to a push pole and push the camera up into each drain. The video camera would provide a real time video picture that could be monitored on a television screen while recording on a video tape. The length to the terminal end of each drain was to be measured using the length measured on the push pole.

Kurt Hafferman, P.E. from Billmayer & Hafferman Inc. was the Project Manager and Field Team Leader and Jeff Robertson and Brandon Chapman from Chapman Construction were the Site Safety and Health Officer and labor force. The project was conducted at the toe of the KDID embankment which is located inside the Exclusion Zone and access is restricted to 40-hour HAZWOPER trained and Level C equipped personnel.

Procedure

We arrived on site at 10:00 a.m. Monday, March 1st, loaded all of the equipment onto the 2-ATV's and then dressed in Level C protective equipment and proceeded to the job site at the toe of the KDID. A photograph of the equipment used is provided in Appendix A, Photographs, page A.1. Equipment used to access the site and conduct the inspection included but was not limited to:

1. 100 ft. Sewer Eye® video camera
2. 9-inch TV/VHS recorder, 3 VHS tapes
3. 100 ft. of 1 ½-inch aluminum push rod in 9.65 ft. end-to-end lock joint sections
4. 2-12 volt marine batteries
5. Black and Decker 120 volt Generator
6. 2-Ranger 4x4 ATV's
7. Sokkia B21 Level, legs, 300 ft. fiberglass tape measure and survey grade fiberglass rod
8. ½ Ton Chevy Truck
9. 3500 psi pressure washer
10. 500 gallon water tank and water
11. Assorted field books, pencils, tape measures, and miscellaneous tools and instruments

The access to the outlet of drains 10 and 11 is the least obstructed so they were the first drains inspected. The television camera, generator and car batteries were placed near the drain outlet and all electrical connections were made and the tape recorder was started. The video camera was attached to

the camera sled and the sled was attached to the first section of push tube. The camera was pushed into the drain 11 pipe and the inspection proceeded from the outlet until a blockage was encountered and the camera sled could go no further. The drain inspection then moved to drain 10, then drain 9, then drain 8 and finally drain 6. We departed the job site at 2:00 p.m., conducted decontamination procedures, and departed the project site at 3:30 p.m.

We arrived back on site at 10:00 a.m. on Tuesday, March 2nd, loaded equipment, dressed in Level C protective equipment and proceeded to the project site. The television and assorted equipment was set up and the drain inspection started with drain 3, then proceeded to drain 4, then to drain 5 and finally to drain 12. We departed the job site at 2:30 p.m., decontaminated and left the job site at 3:30 p.m.

We arrived back on the site at 9:00 a.m. on Wednesday March 3rd and loaded survey equipment into one of the ATV's and Kurt Hafferman and Jeff Robertson proceeded to the job site. The distance on the face of the embankment to the terminal end of each of the drains was measured with a level tape and a lath and flag was placed on line with the drain on the face of the embankment at the terminal end. The elevation from the drain outlet to the lath at the terminal end was surveyed using the Sokkia level and fiberglass rod. The terminal end was staked and flagged for drain 12, drain 10 and 11, drain 8, and drain 5. A photograph was taken of the location of the lath. We departed the site at 12:00 p.m.

Discussion

Drain 1, Drain 2, and the outlet end of Drain 3 were previously video taped in December of 2008 prior to cleaning the drains. The video and photographs for Drains 1 and 2 is from that December 2008 inspection. The outlet ends of all the drains were cleaned in December of 2008. Drain 3 and all other drains, except Drains 1 & 2, were video taped again during this March 2010 project.

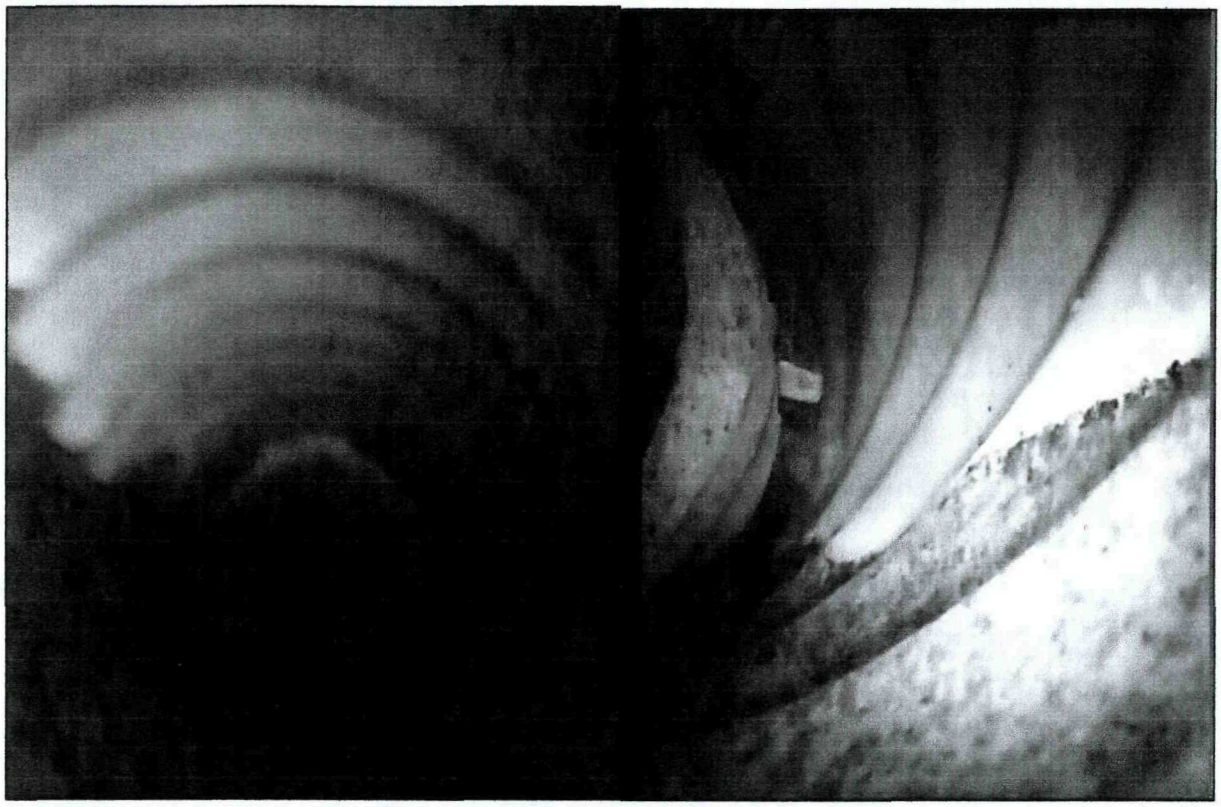
Copies of the all of the data on the VHS video tape recorded in the field were transferred to a digital video disk (DVD) and are provided in the video folder in Appendix B to this report. The DVD's are provided in the order the drains were video taped and include;

- Volume 1: Drain 1, Drain 2, and Drain 3 from December 2008,
- Volume 2: Drain 11, Drain 10, Drain 9, Drain8, and Drain 6,
- Volume 3: Drain 3, Drain 4, Drain 5, and Drain 12, and
- Volume 4: All of the drains on one DVD, except the video have been edited to remove the redundant or motionless portions of the video.

The following is a description of the inside of each of the drains based on interpretation of the video tape as well as the on site observations of BHI and Chapman Construction personnel. The descriptions are listed in the order of the drains location on the embankment toe and not necessarily in the order they were video taped. Still photographs are taken from the video through a "print screen" copy pasted into the report as a still image.

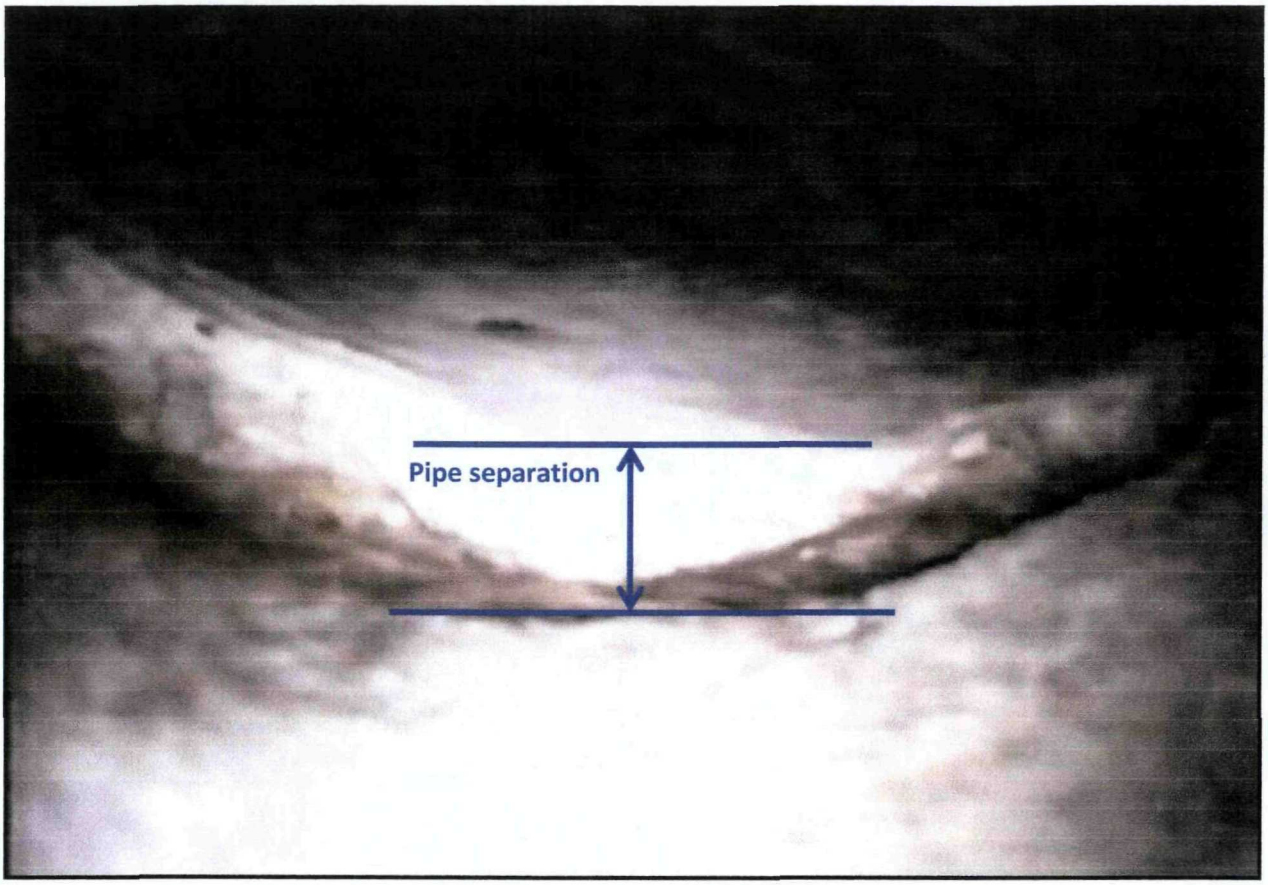
Drain 1: Drain 1 is located in the far right abutment and starts with a 12-inch corrugated metal pipe (CMP) then transitions into a 10-inch reinforced concrete pipe (RCP) approximately 10 ft. from the outlet. The transition is shown in Figure 1 below:

Figure 1: Drain 1 Transition



The inside of the CMP and the RCP are clean and there are no apparent large cracks in the pipe. There are perforations in the RCP that apparently allow water to flow into the pipe. It was noted that the drain is composed as individual 5 ft. segments. At each of the segments, there are separations in the pipe joints. It is noted that the separations are wider and are displaced more than any of the other joints in the other drain pipes as well as more than a typical RCP which have tight joints at the segments. It appears that water flows into the pipe at the pipe segments rather than at the perforations and that there has been embankment material that has been washed into the pipe through the joints. It appears that the individual segments of the pipe have been slightly rotated and displaced due to the missing material. A photograph copied from the video located at one of the larger pipe gaps is shown in Figure 2 below;

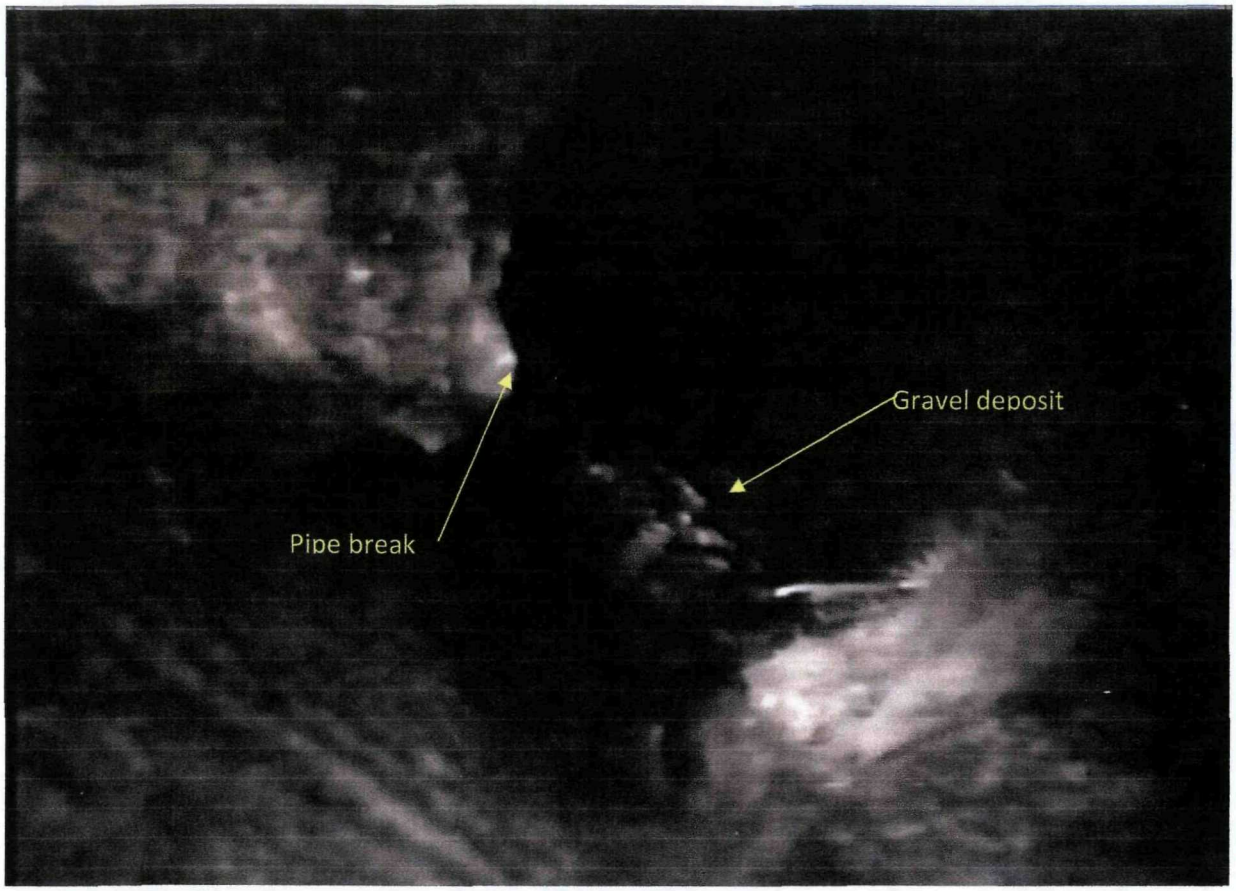
Figure 2: Drain 1 pipe joint gap



The camera inspection went a total of 90 ft. when it encountered a pipe joint that the camera could not pass but it was almost the total length of the video camera so the inspection was terminated. Other than the gaps at the pipe segments there were no other anomalies noted in drain1.

Drain2: Drain 2 is a 12-inch corrugated metal pipe that goes in approximately 10 ft. then angles to the left (toward the embankment) approximately 22 degrees. A photograph of the pipe angle copied from the video is shown on page A4 in Appendix A photographs. Because the video camera on the sled could not negotiate the bend to the left, the camera was removed from the sled and was pushed into the drain as far as was possible around the angle. The drain was clean for the first 10 ft. up to the bend then approximately 5 ft. after the bend in the pipe (15 ft. into the pipe) there was a growth of moss and roots and what appears to be a break in the pipe and with a large pile of gravel. Water was seen flowing out of the pile of gravel. A copy of the video at the location of the gravel deposit is shown in Figure 3 below:

Figure 3: Drain 2 at gravel deposit



It appeared that the gravel was infiltrating into the pipe at the break in the pipe. Water was seen flowing out of the side of the pipe and into the gravel. The overall condition of the pipe was determined fair to poor in that the metal does appear rusted, the pipe is broken or separated, and it is likely that the overall metal thickness is less to much less than a new pipe.

Drain 3: Drain 3 is a 10-inch RCP in the left toe of the embankment. The first 5 ft. of drain 3 was unobstructed and then the camera encountered what appears to be a concrete headwall. The outlet end of Drain 3 abuts the headwall but has risen up above the invert of the pipe that is on the other side of the headwall. Once the camera crossed the headwall, it dropped onto the invert of the pipe and went immediately underwater. The water is very turbid and the light from the video camera could not illuminate the pipe so no video was available. A photograph of the headwall is shown in Figure 4 below;

Figure 4: Drain 3 Concrete Headwall

The camera emerged from the water at approximately 31 ft. from the end of the outlet and then the path of the camera was relatively unobstructed. As can be seen in the video, the pipe appears open and there is water running in the invert of the pipe.

There are deposits of either dirt or calcium carbonates on both side of the invert that form a narrow path in the middle for the water. The deposits were easily disturbed and may have fallen off when the camera was withdrawn from the drain.

We were able to push the camera the full 100 ft. of cable length and at the end of the camera cable, the pipe continued on and appeared unobstructed. This is the only drain in the embankment that does not terminate in a pile of rocks and debris and appears relatively intact for the length of the pipe. Due to the length limitations of the video camera, it is not certain how much further the pipe goes into the embankment.

Drain 4: Drain 4 appears to angle slightly toward and possibly under drain 3 and ends just 14 ft. from the outlet end of the pipe. There is no appearance of a headwall so it is not certain if the drain ends before the headwall in drain 3 or if the headwall in drain 3 is just the terminal end of a pipe encased in concrete. The camera sled was pushed 14 ft. into the drain and shows a pile of rocks with water emerging at the terminal end. It appears that the pipe is broken and the rocks have migrated into the drain as there is no appearance of the end of the pipe. The drain rock also has roots and other debris in the rock matrix and there appears to be a tan deposit on the invert of the pipe. It is suspected that the tan deposit is a combination of silt, rust and iron bacteria.

Drain 5: Drain 5 is a 10-inch corrugated metal pipe in fair to poor condition. Flow from drain 5 is always low to very low flow although there are slight seasonal changes in the flow rate. The camera shows a combination of sands and roots on the invert of the pipe throughout the length of the pipe. The camera was able to go approximately 45 ft. into drain 5 until it reached a pile of what appears to be roots, rocks and sand. There is also a brown to tan deposit of material on the invert of the pipe and the sides of the rocks. The tan material was easily displaced and cannot be seen when the camera is withdrawn from the drain pipe. This same silty tan deposit is also present in drain 4 and drain 8 which is also a rusted CMP in fair to poor condition. It was assumed in the field that the tan deposit may be a combination of silt, rust and/or iron bacteria growth. It may be that it is also calcium carbonate deposits but it is not easily identifiable. It appears that the pipe has collapsed or broken somewhere upstream of the pile of rocks and the rocks and sand has migrated into the pipe as there is no appearance of a terminal end of the pipe.

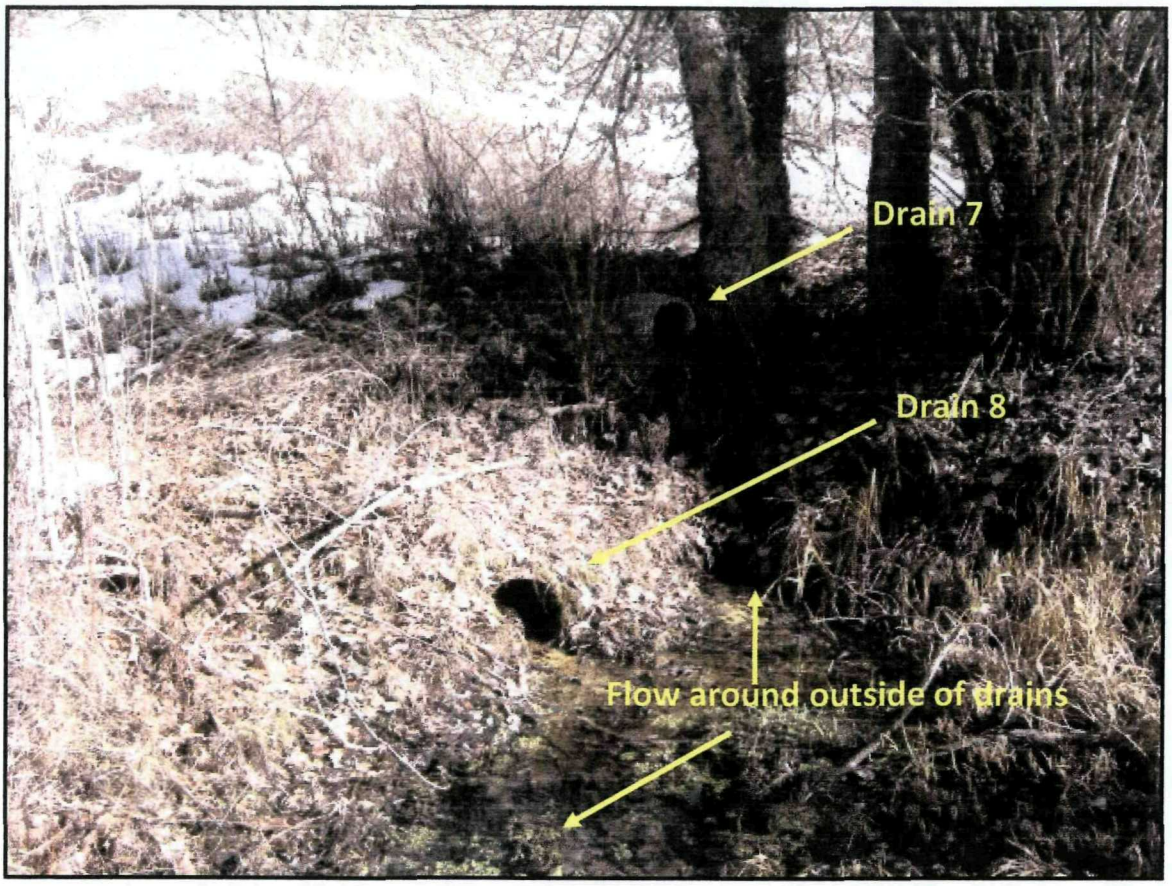
Drain 6: Drain 6 is a 14-inch O.D. steel pipe that conveys the majority of the toe drain flow. The video camera was immediately submerged into water at the entrance and the air bubbles and turbulence in the water caused the video camera to continually be in and out of focus and the condition of the pipe was not always discernable. At about 50 ft. into the pipe the camera went underwater and the bottom of the pipe could be seen. It appears that the metal in the pipe is pitted and there is some metal deterioration. The camera was able to be pushed the full 100 ft. into the pipe unobstructed. At the end of the 100 ft. cable length we were able to rotate the camera out of the water and the top of the pipe could be seen. The metal was, again, rusty and pitted. For as much of the pipe as could be seen, the pipe appears to be in good to fair condition and there were no areas were cracks appeared or water was noted as flowing into or out of the pipe.

Drain 7: Drain 7 is plugged with dirt and was not inspected.

Drain 8: Drain 8 is an older corrugated metal pipe that appears to be in fair to poor condition. The first 5 ft. of the outlet end of the pipe has rusted and the metal is thin. After the outlet end, the metal appears to be in better condition. This drain has the lowest invert elevation of all the toe drains. The water that flows out of drain 8 is usually a low flow, but is clear and steady. There are some minor fluctuations in drain flow rate with seasonal inflows but the increase in flow mainly comes from the water flowing on the outside of the drain pipe rather than from the flow inside the pipe. The outlet of drain 8 sits in a very wet area where water flows out of the ground around the outside of the outlet of the pipe as well as out of the ground approximately 4 ft. to the left of the outlet of the drain, just below drain 7.

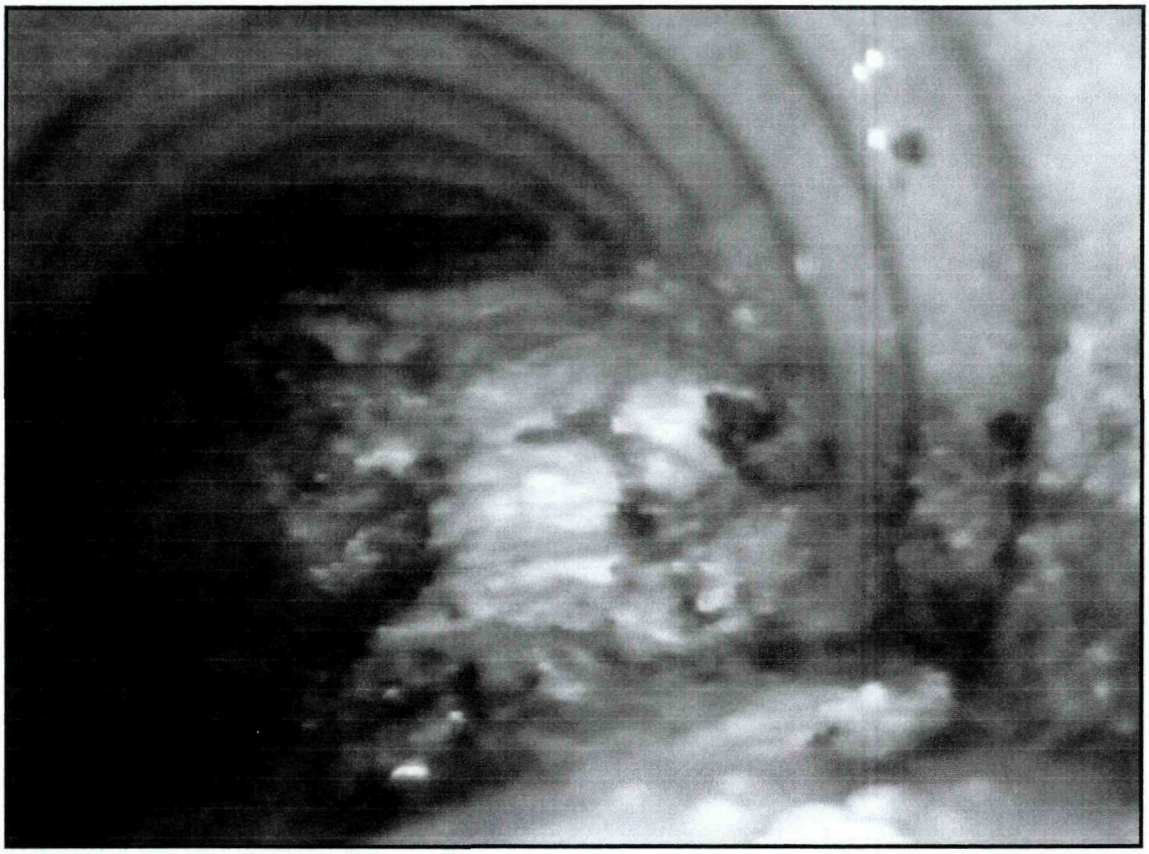
It is assumed that the water that would normally flow out of drain 7 is some of the water that appears below and next to drain 8 but that assumption is not certain. We have noted that the water that appears outside of the drain 7 and drain 8 fluctuates each year with the seasonal flow increases and decreases. A photograph of the water appearing on the outside of drain 8 is shown on Figure 5 below;

Figure 5: Flow from outside of drain 8



The video camera was able to travel 18.6 ft. into drain 8 before encountering a pile of rocks inside the pipe. There is the same tan silt or clay deposits on the invert of the pipe and inside the pile of rocks as was in drain 4 and drain 5. The rocks appear to be 1-1/2-inch angular rock with dirt, sand and roots inside the matrix of rocks. It does not appear that the pipe has collapsed in the area where the rocks are located but the rocks have migrated into the pipe from some upstream location. It appears that the smaller particles of rock and sand are migrating down the pipe. A copy of the video at the terminal end of the pipe is shown in Figure 6 below:

Figure 6: Drain 8 silt and clay in rock matrix at the terminal end

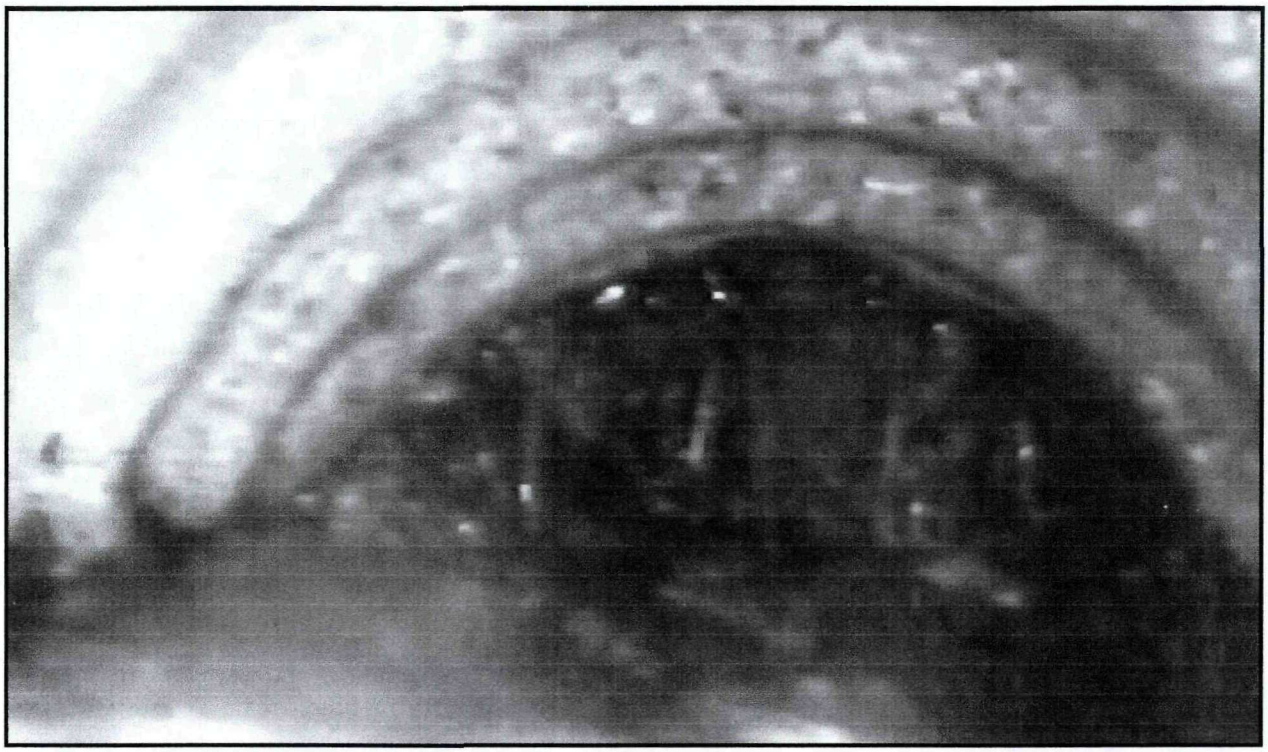


Drain 9: Drain 9 is a 10-inch RCP. The outlet of the pipe is in good condition and the concrete appears to be sound. It is noted that near the entrance to the pipe there are roots present and silt is on the invert of the pipe for most of the length. At 30 ft. into the pipe, the pipe starts to appear out of round and the top looks to have collapsed or was crushed. The pipe is still intact but there is evidence of cracks all around the pipe near the terminal end. The camera was pushed into drain 9 a total of 43.9 ft. where it encountered a pile of rocks and debris. The rocks at the end of the pipe are in a sand and dirt matrix and are approximately 1-1/2-inch angular rock. It appeared that the pipe has crushed and broken somewhere beyond the rocks and that the rocks have migrated into the drain and settled into a stable position. There is no indication of the actual terminal end of the pipe.

Drain 10: Drain 10 and 11 are located approximately 4 ft. apart in the same location. Drain 10 is a 10-inch CMP and drain 11 is a 10-inch RCP. It is noted during the routine owner's inspections that the invert of the both of these pipes is continually covered in 1-inch to ¾-inch rocks and that the rocks appear below the pipe outlet on the streambed. In drain 10 the camera was pushed in 13.6 ft. where the camera encountered what appeared to be a concrete headwall or the terminal end of a concrete pipe. The end of the pipe was packed tight with rocks and dirt as well as roots and no voids were readily apparent. The rocks appeared to be ¾-inch to 2-inch angular and round rock. The water was emerging from the rocks from the top and bottom and flowing into the pipe. Water also appeared to flow out of

the pile of rocks that had migrated into the pipe on the invert indicating that water is flowing into the invert under pressure from the perforations. A copy of the video at the terminal end of drain 5 is shown in Figure 7 below:

Figure 7: Terminal end of drain 10



Drain 11: Drain 11 is a RCP in fair to good condition near the outlet. There are 1-inch to ¾-inch rocks on the invert, the same as the condition in drain 10. The camera sled was able to travel 10 ft. into the pipe when it encountered the first rocks that had migrated into the invert of the pipe. It was also noted that water is spraying into the pipe from the perforations along the invert. This would seem to indicate that there is water present in the embankment that is under pressure up to at least the elevation of the invert of the pipe. The camera was pushed over the rocks on the invert to a total length of 12.6 ft. and then was stopped at a larger pile of rocks at the terminal end. The terminal end of at least one of the pipe segments could be seen and then there was a void space past the end of the pipe with a pile of round rocks past the void space. The round rocks were ¾ -inch to 1-inch round rocks, with sand. The rocks and sand have migrated into the pipe and have left the void space. There was also water emerging from the bottom of the rocks and flowing into the pipe. A copy of the video at the terminal end of the pipe and the void space at the end of the pipe is shown in Figure 8 and Figure 9 below;

Figure 8: Terminal end of drain 11

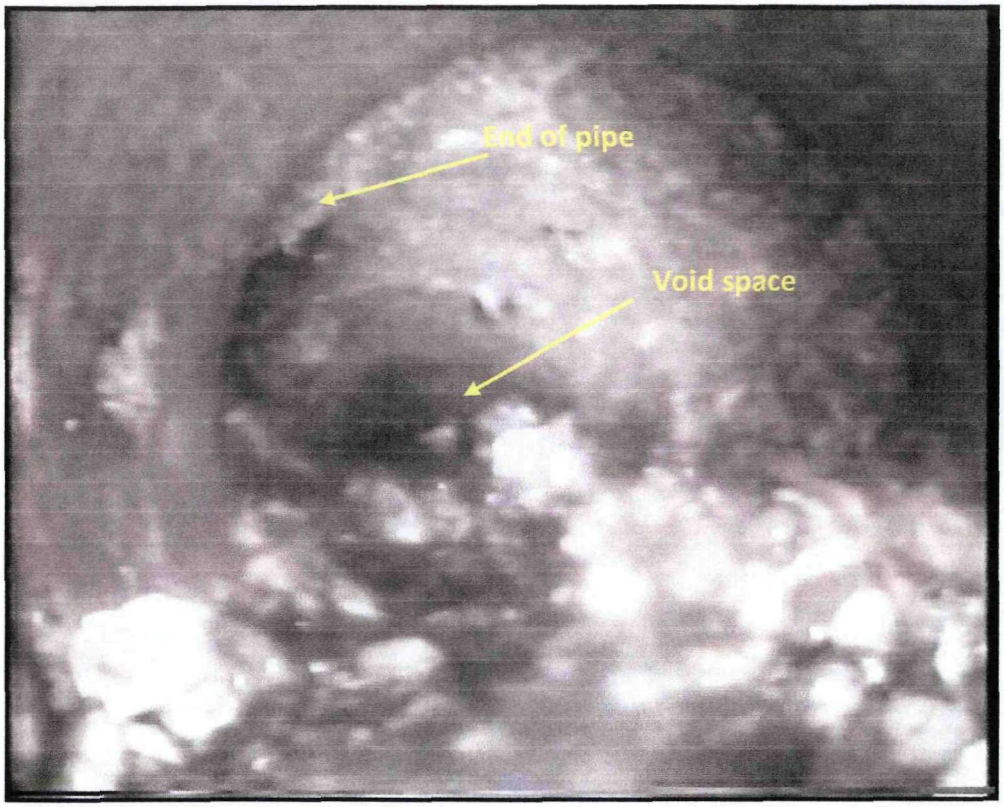
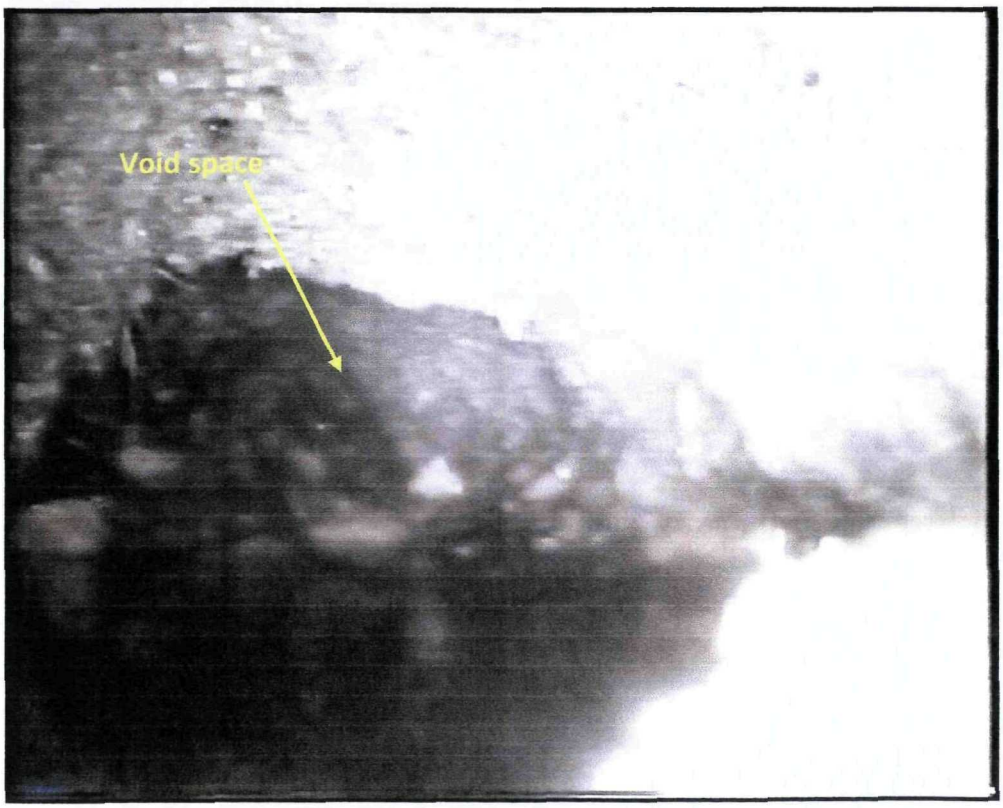
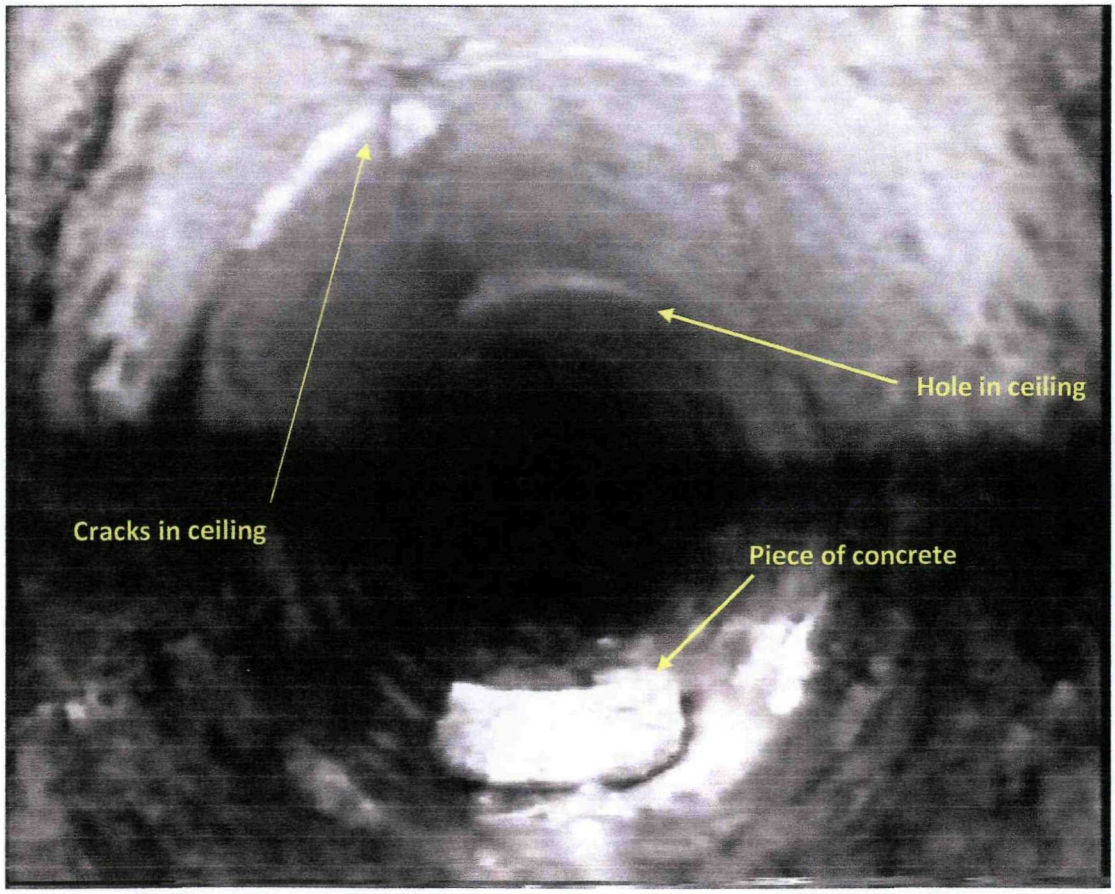


Figure 9: Void space at the end of drain 11



Drain 12: Drain 12 is 8-inch RCP and is the smallest of the toe drains. Drain 12 has a clear and steady drain flow that changes with the seasonal fluctuations of the inflow. The lower end of the drain was fairly clear although there is a small deposit of sand and gravel in the invert of the pipe approximately 20 ft. into the pipe. It was noted that the video camera recorded flow into the drains from the perforations on the lower sides of the pipe until approximately 41 ft. into the drain where the flow ceased. The camera was able to be pushed another 10 ft. into the pipe where it encountered a pile of wet sands and gravel on the invert of the pipe and finally a complete blockage of the pipe. The material at the terminal end is round rock and is approximately 1-1/2-inch diameter with coarse sand. The material was wet but there did not appear to be water flowing out of the material. It is also noted that the pipe appears to have been crushed at approximately 30 ft. in from the end of the pipe and the pipe appears out of round for much of the length beyond 30 ft. There are also cracks in the pipe and a piece of the concrete from the ceiling that has fallen onto the invert of the pipe at 45 ft. in from the end. A copy of the video from drain 12 where the concrete piece from the ceiling is located is shown in Figure 10 below;

Figure 10: Drain 12 at location of concrete piece and ceiling cracks



On Wednesday, March 3rd, BHI and Jeff Robertson from Chapman Construction returned to the site to locate the terminal end of the each of the drains on the embankment. A level distance was measured to the end of the drain and a lath with ribbon was placed. The elevation from the outlet of the pipe to the terminal end was also surveyed to determine the height of overburden at the terminal end point of each drain.

The Wednesday March 3rd survey was conducted to determine if there is some correlation to the terminal end of the drains. It was found that the ends of drains 12, drain 9, and drain 5 are in somewhat of an alignment and that drains 4, 8, 10, and 11, are in another alignment. Shown below in Figure 11 is the lath at the terminal end of drains 4 and 8 and in Figure 12 is the terminal end of drains 5, 9 and 12, as well as drains 10 and 11.

Figure 11: Terminal ends of drain 4 and drain 8 on the toe of the embankment.

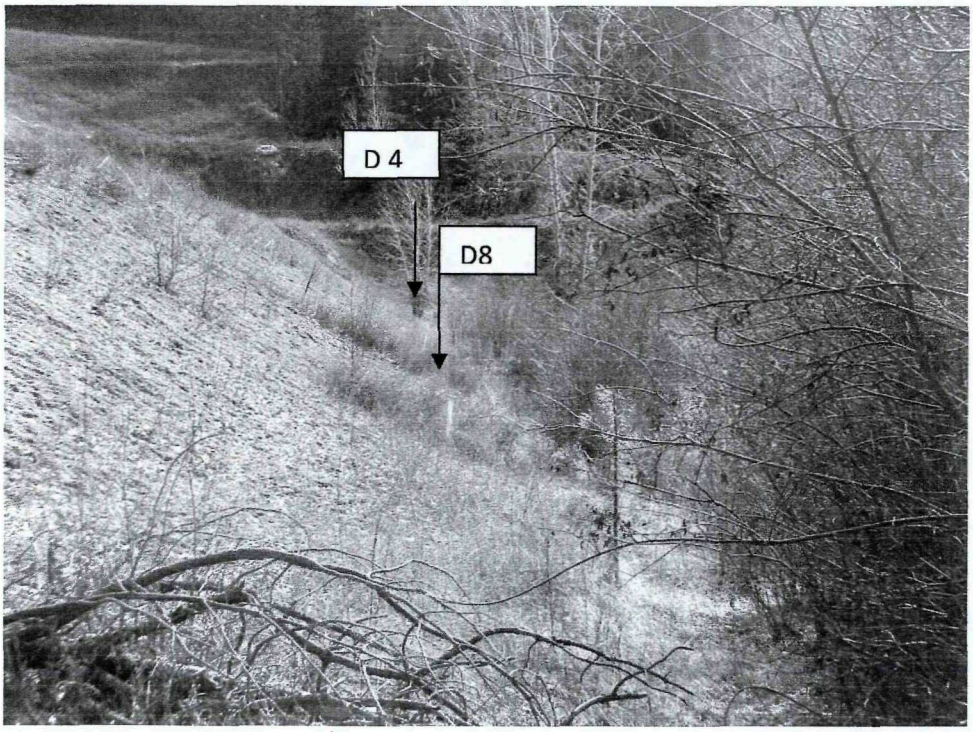
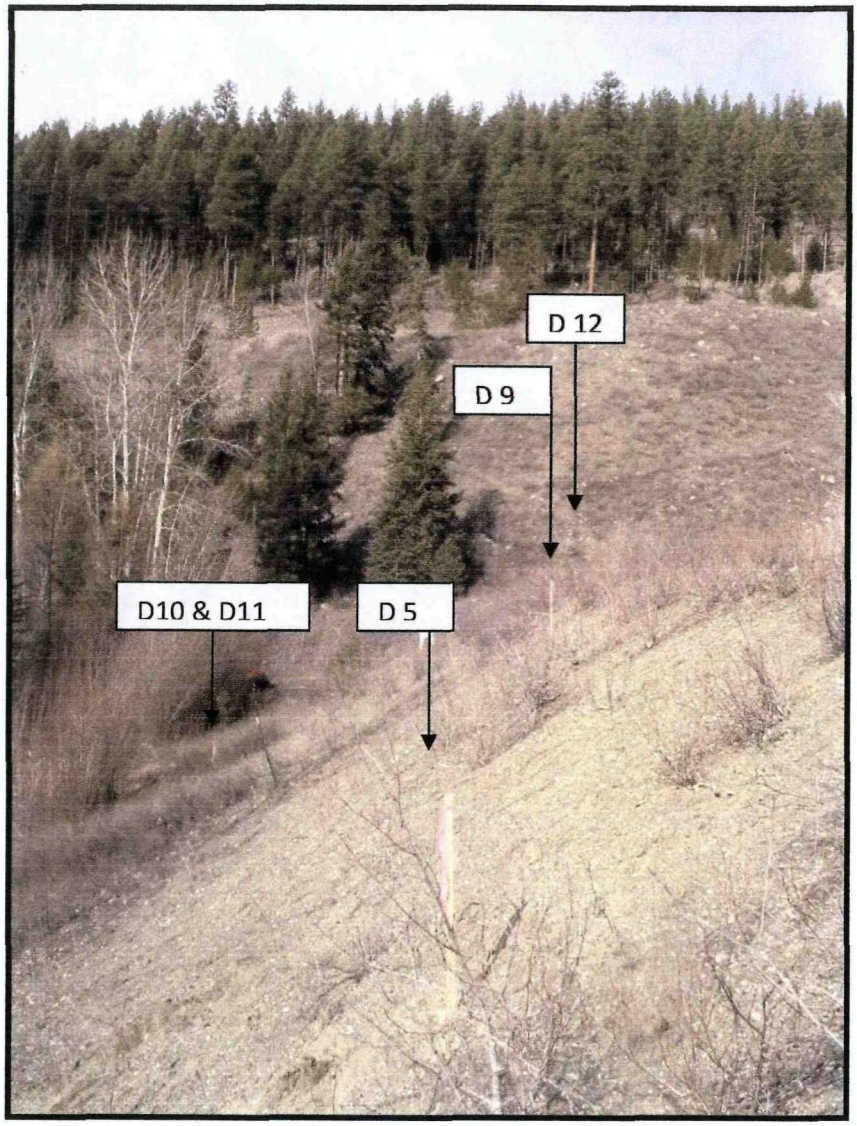


Figure 12: Terminal ends of drains 5, 9, and 12 and drains 10 and 11 on the toe of the embankment.



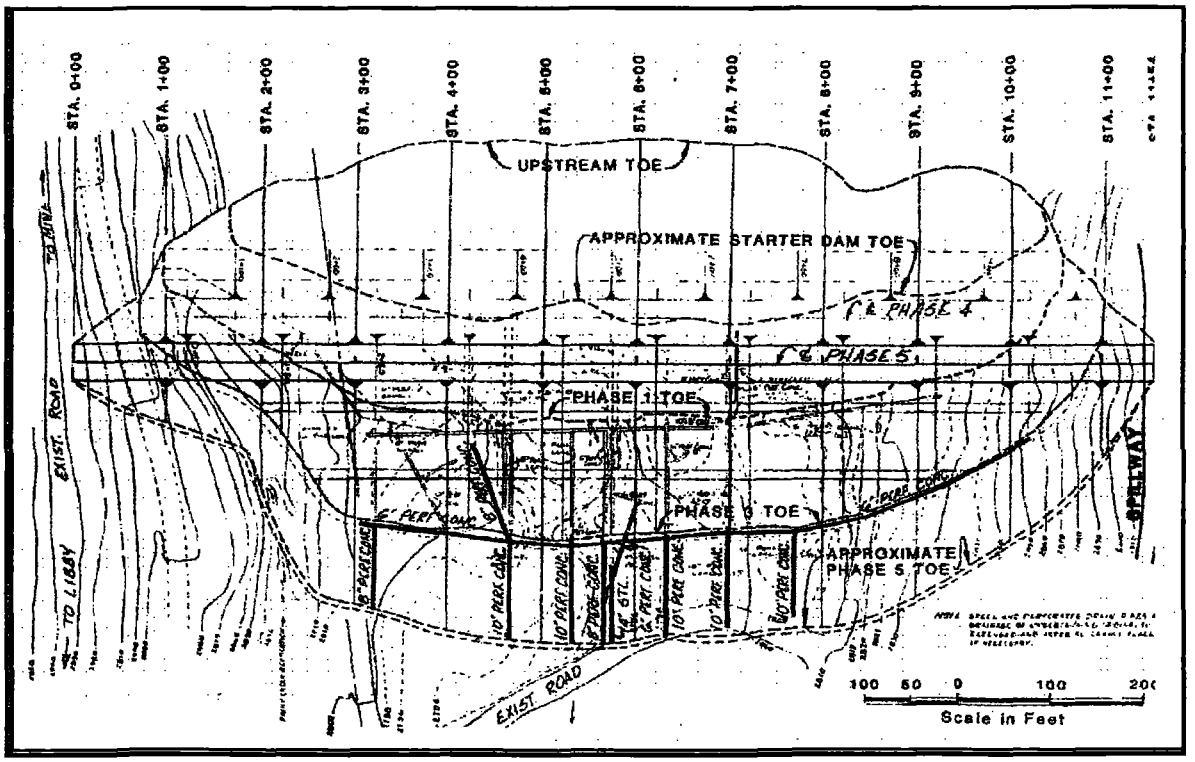
As can be seen the terminal ends do appear to be in somewhat of an alignment. Drains 4, 8, 10, and 11 are at a location that averages 14 ft. from the toe of the embankment and drains 5, 9, and 12 are at an average distance of 45 ft. from the toe of the embankment. Drains 4, 8, 10, and 11 are basically at the toe of the embankment and drains 5, 9, and 12 are just below the downstream crest of first lift on the embankment. The drains 5, 9, and 12 are not at an equal distance below the crest of the first lift. Drain 12 is just below the crest, drain 5 is approximately 10 ft. below the crest and drain 9 is in the middle between the two.

Results

The terminal ends of the current toe drain system were found to have no relation to all of the previous understanding of the drain system from the plan drawings or written statements. The main written statements were provided in the Harding Lawson Associates Geotechnical Evaluation of February 1992[1] in which they state on page 13 of 20; *"During construction of the embankment, a series of 20-foot-wide 2-foot-high drainage blankets consisting of native gravel material was placed at the embankment foundation level. Eight-inch-diameter perforated pipes were embedded within the drainage blankets to collect the water and transport it to the downstream side. These pipes were connected to a single 14-inch-diameter pipe which was extended at each subsequent stage of construction and presently emerges from the downstream side."*

The Harding Lawson statement is supported by the plan drawings that were provided as part of the US COE Phase 1 Dam Safety Inspection conducted by Morrison-Maierle for the COE in 1982. There are two drawings available from the 1982 Morrison-Maierle Phase 1 Dam Safety Inspection Report; a plan view and a cross section. Copies of the Phase I inspection drawings are provided in Appendix C, page C1 and C2. A copy of the plan view shown on page C1 in the appendix showing the assumed location of the drains is shown in Figure 13 below:

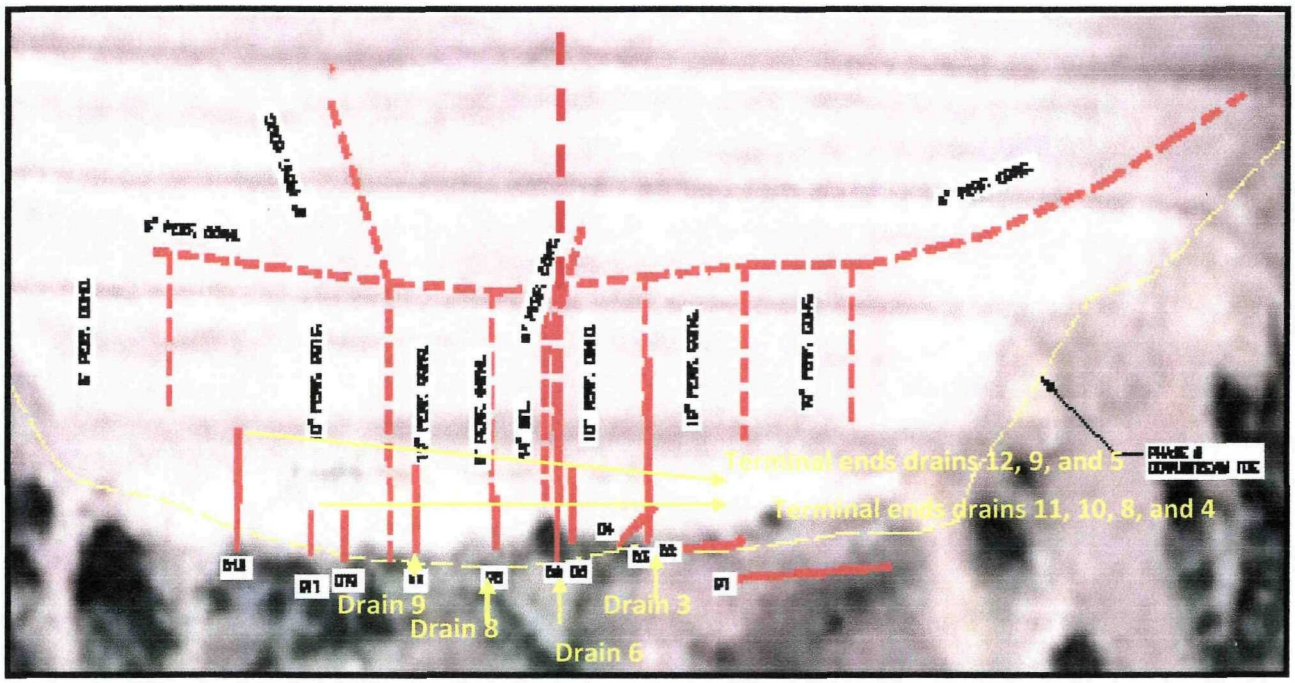
Figure 13: Phase 1 Dam Safety Inspection Assumed Location Toe Drains



[1] Harding Lawson Associates Geotechnical Evaluation W.R. Grace Dam Rainy Creek, Montana, Vahdani, Hanson, Lawson, February 3rd, 1992

A plan view showing the assumed drain locations from this drawing that has been superimposed on a 2009 color aerial photograph is provided in Appendix C, on page C3. A second view showing the existing drain locations and scaled lengths, superimposed on a 2009 color aerial photograph, is provided on page C4 and a third drawing showing both of the locations is provided in Appendix C, on page C5 to this report. A copy of the section of the page C5 drawing that includes both the existing and assumed drains is shown in Figure 14 below:

Figure 14: Assumed and Existing Toe Drains



The dashed lines in Figure 14 and on the drawing in the appendix are the 1982 assumed locations and the solid lines are the 2010 existing locations. As can be seen, the assumed and existing locations for drain 3 and drain 6 do appear to align with the 14-inch steel drains and the 10-inch perforated concrete shown on the assumed location drawing. There may also be some correlation to the locations of drain 8 and drain 9 but even these assumptions would not describe why there were eight (8) drains assumed and there are twelve (12) drains existing. A description of the length of each of the existing drain pipes and the height of the overburden from the field notes and field survey is provided in Appendix D to this report.

The survey measurements taken on Wednesday March 3rd would seem to indicate that the existing drains were completed as two different lengths and the different lengths represent two different toe berms. This description neither matches the description previously provided, nor does it make sense that someone would have simply provided drain pipes stubbed into a gravel toe berm at random locations. At the very least, it would be assumed that there should be a cross drain tied into the terminal ends in order to assure that the flow through the gravel is collected and discharged on the outside of the embankment at uniform locations. If that were the case we would expect to see two

cross drains, one approximately 14 ft. from the toe and one approximately 45 ft. from the toe; neither of these exist.

If the Harding Lawson statement were taken literally we would not expect to see any drains on the toe other than the 14-inch steel pipe at the center of the dam.

It is possible that the drains shown in the US COE Phase 1 report were not plotted correctly and were installed in the locations closer to the existing drains and extended during each subsequent stage of construction and 8 drains shown were changed to the 12 drains existing. If that were true then it would indicate that they have collapsed or were crushed and have filled with gravel or embankment material. This would assume that water is finding a path to each of the drains and embankment material that filled the drains has washed the fine material away, leaving just the larger rocks and sands that the water can not move.

Needless to say, finding rocks inside of the drains at the terminal ends was not expected nor was it expected to find a headwall in drain 3 and drain 10 and no others. There is no information in any of the previous documents or in the previous Harding Lawson report that indicate that there is either a gravel toe berm or a concrete headwall and no other indications of gravel or rocks placed near or in the drain pipes. As the rocks are a combination of round and angular rocks and that some are just the clean rocks and others are a combination of rocks and sand, it would also indicate that the source of the rocks is different and may be coming from different phases of construction. Again, there is no discussion of a phased toe berm construction.

The only drain that was found to be in the condition anticipated was Drain 6. Drain 6 was just as expected, it is open and unobstructed for the 100 ft. investigated and there is nothing unusual noted in drain 6. The pitting in the metal of the pipe is not unusual for a pipe of this age but does indicate that the pipe is aging.

There are no plans or descriptions of drains 1 and 2 and it is not certain if both of the drains continue on in the same direction they are currently in or if drain 1 bends into the embankment like drain 2 or how far they both go. These are the only drains that do not run water all year so it seems that they are not tied into the same drain material as the other drains. They will only flow water from late March to late June and are dry for all other parts of the year. Drain 1 is in good to fair condition and drain 2 is in fair to poor condition.

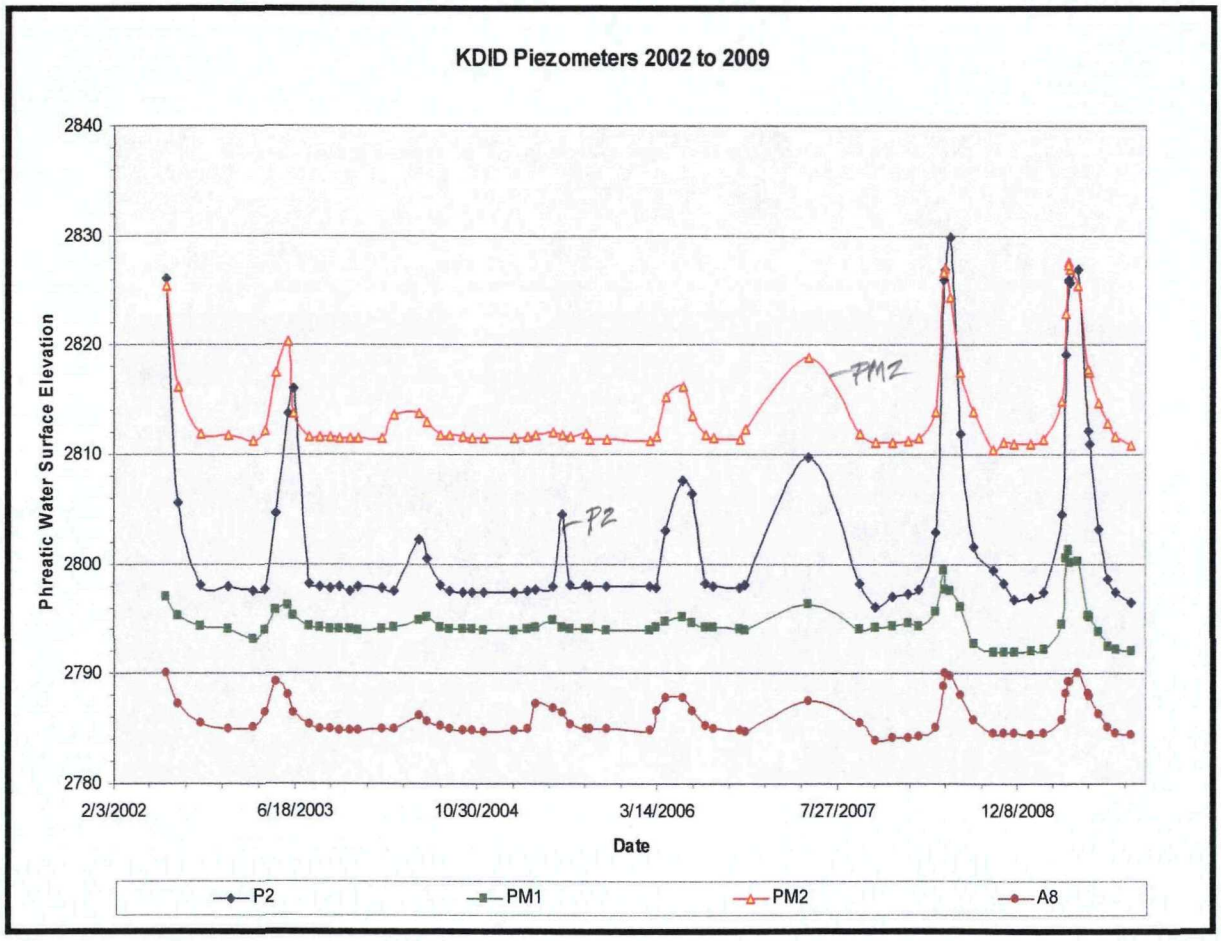
Drains 10 and 11 are continually moving gravel material as ¾ inch rocks are often seen on the invert and at the end of the pipe below the outlet and no other drains appeared to move large gravel. The concrete pipe or headwall found at the end of drain 10 and the space found at the end of drain 11 were unusual in that and no other drains had the same kind of pipe end and large void spaces.

Drain 3 appeared to continue on into the embankment as was originally anticipated so in that sense, drain 3 is also found to be in the condition anticipated; except the other drains end in a rock pile.

Conclusions and Recommendations

In the Harding Lawson report, Stability of Slopes, page 15 of 22, they state that *"...we believe that the groundwater level immediately upstream of the embankment does not rise above the foundation level."* In the BHI report on the Piezometer and Toe Drain Discharge Monitoring of February 2010 it is noted that the phreatic water surface in piezometer P2 on the upstream face of the embankment rises as much as 30 ft. to 40 ft. above the foundation level. It is also known that the phreatic water surface drops each year to the bottom of the piezometers after the high spring flows pass. A graph of the phreatic water surface in the four piezometers that have an active rising water surface since 2002 is shown in Figure 15 below;

Figure 15: Phreatic Water surface 2002 to 2009



Continuous records for the piezometers have only been available since 2002 which indicates that either the piezometers have always risen and it was just not known by Harding Lawson Associates, or the rise in phreatic water surface has occurred some time after the 1992 Haring Lawson report. As was stated in the Piezometer and Toe Drain Discharge Monitoring report, the rise in phreatic water surface is still 70 ft. below the maximum phreatic surface assumed in the stability analysis so the rise in phreatic water

surface was not tied to a stability issue. But, if there has been a radical change in the phreatic water surface since 1992, it may have been caused by the collapse of the drains.

It has also been noted in recent inspections that water is now appearing on the ground surface at the toe of the dam near piezometer A8. This surface water has not been previously reported and it is not certain if it appeared before and was not noticed or if it is weather related but it will be monitored. It has also been noted that small amounts of water are starting to appear further and further down from the toe of the embankment. This is indicating that the flow through the embankment may not be fully collected in the toe drain system and is exiting from the foundation downstream of the toe of the embankment rather than through the drain system.

As discussed in the BHI Piezometer and Toe Drain Discharge Monitoring report, 88% of the total volume of water from the Upper Rainy Creek drainage saturates the tailings in the impoundment area and is conveyed through the drain system. With the rise in phreatic water surface, the appearance of water on the surface near the toe of the embankment, and with water emerging further downstream of the toe of the embankment, it seems to indicate that the capacity of the drain system may have changed since the 1992 Harding Lawson evaluations. It is possible that the pipes in the drain system have collapsed.

Ultimately it may be that there are indications beginning to emerge that the time has come to consider recommendations in the Harding Lawson report, Conclusions page 20 of 22 which states that "Mitigating measures such as the installation of a blanket drain, chimney drain, or other drain system near the downstream toe should be adopted..."

It is recommended that five exploratory projects be conducted to further understand the condition of the drains system.

1. The break in drain 2 needs to be repaired. As the break is near the surface and easy to access, the pipe can be excavated, and a new segment added to the end of the drain.

2. Drain 3 needs to be further inspected as it now appears that it is one of the drains that may give an indication of the internal parts of the embankment. It is recommended that the outlet end of drain 3 should be removed and allowed to drain out the water and dirt in the invert. Once the end is removed the pipe should be clear and can be re-inspected. It is unknown how far drain 3 goes into the embankment but a camera capable of at least 300 ft. should be available in the event that access can be obtained. Once the pipe is cleaned and inspected, the outlet end from the headwall down can be placed on a ¾-inch angular rock base and correctly aligned from the concrete headwall to prevent siltation at the outlet.

3. The void space at the terminal end of drain 11 should be excavated. If the void is left in the embankment it is likely that the roof of the space will eventually collapse and may block the drain or wash more embankment material out and create a bigger void or a depression on the surface. As the terminal end of the drain is located less that 15 ft. from the end and as the overburden above the end is estimated to be less than 5 ft., it is recommended that drain 11 be excavated and that washed drain rock be placed in the void space. While the excavation occurs

it will provide an opportunity to investigate the embankment material around the drain and determine if there is more gravel present that may be indicative of a toe berm.

4. The excavation will be used to determine if there is material present that would indicate the presence of a gravel toe berm and to repair the void space.

5. It is not certain if there will be an opportunity to have a camera that will give a clear view of the inside of drain 6 unless the camera is elevated above the water surface. It is recommended that a push camera be used that has at least 300 ft. of length and that a sled be developed that can be elevated enough to be out of the water as much as is possible. It is hoped that the connection to the cross drains discussed in the Harding Lawson report can be located.

6. Remove the outlet end of drain 7 and see if it is possible to find the rest of the drain pipe and inspect the length.

7. Install three shallow hand-augured piezometers near the existing piezometer A8. Monitor piezometers during the spring flows of 2010 to determine the correlation to drain flows, A8 piezometer rises and the appearance of seepage below the toe of the embankment.

At the conclusion of the exploration we will provide information to show the following;

1. Does drain 3 terminate in a 6-inch perforated cross drain? If so, it may indicate that all other drains originally terminated in the same cross drain but have since collapsed.

2. Determine if there is a gravel toe berm near drain 11 that may explain why the drains end in gravel piles.

3. Determine if there is a cross drain connected to drain 6 that may confirm the original statements as well as explain where water is either collected from or may be flowing out from drain 6.

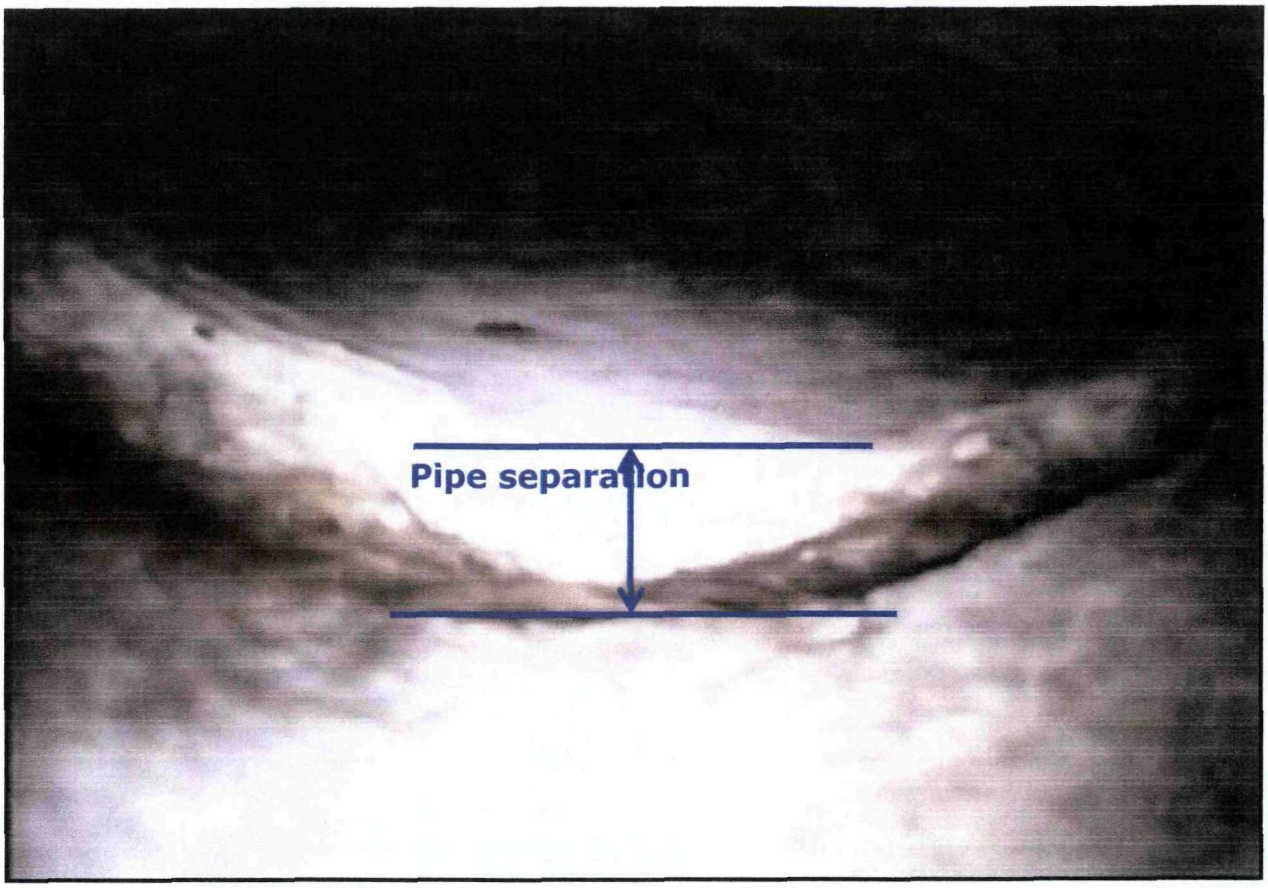
4. Determine if the surface water near piezometer A8 is emerging up from the foundation or laterally through the embankment.

If the work is conducted before the last week in April the drain flow should remain low and it may still be possible to get work completed before the higher spring flows in late May.

APPENDIX A

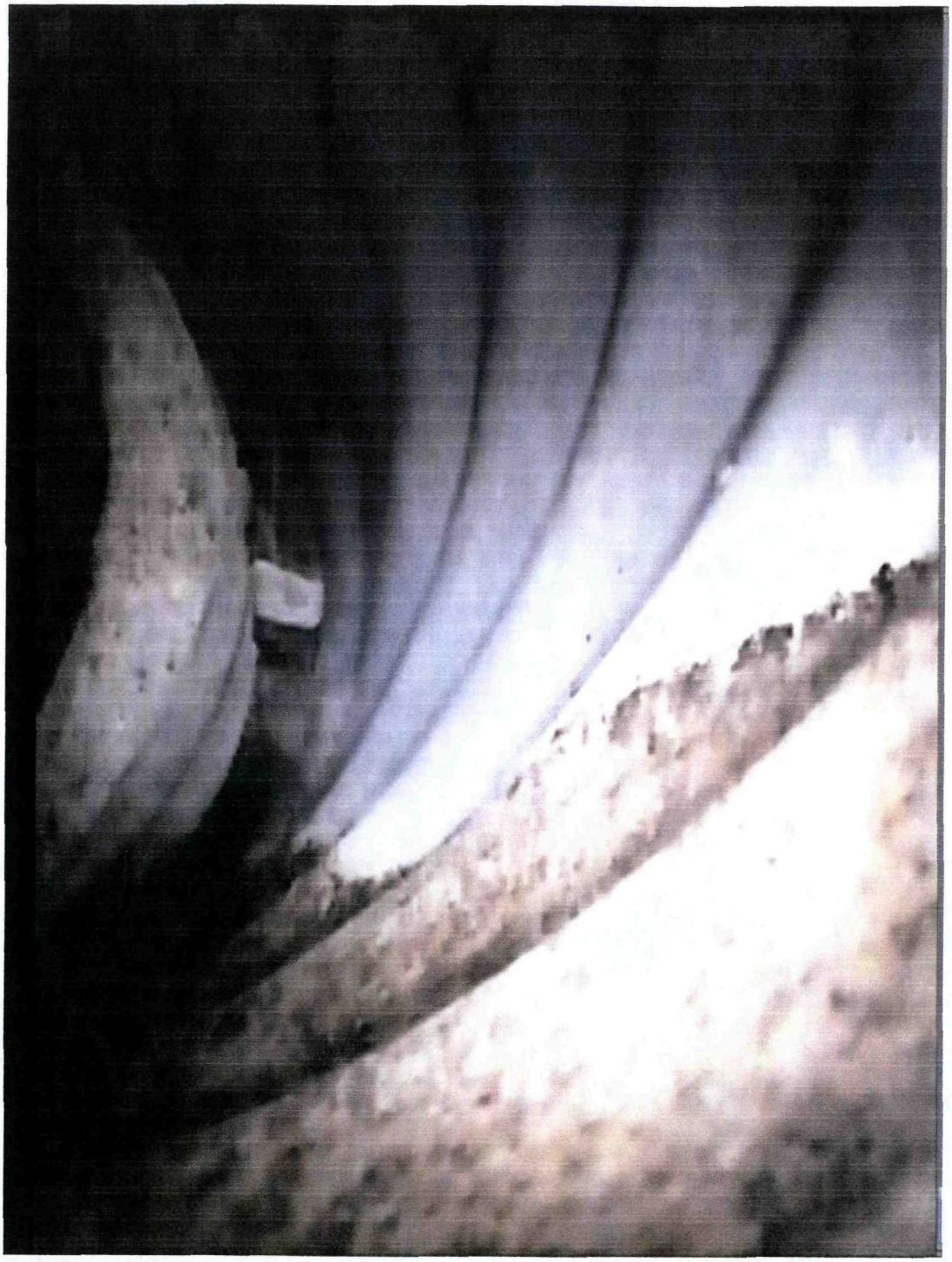
PHOTOGRAPHS

Drain Inspection Equipment

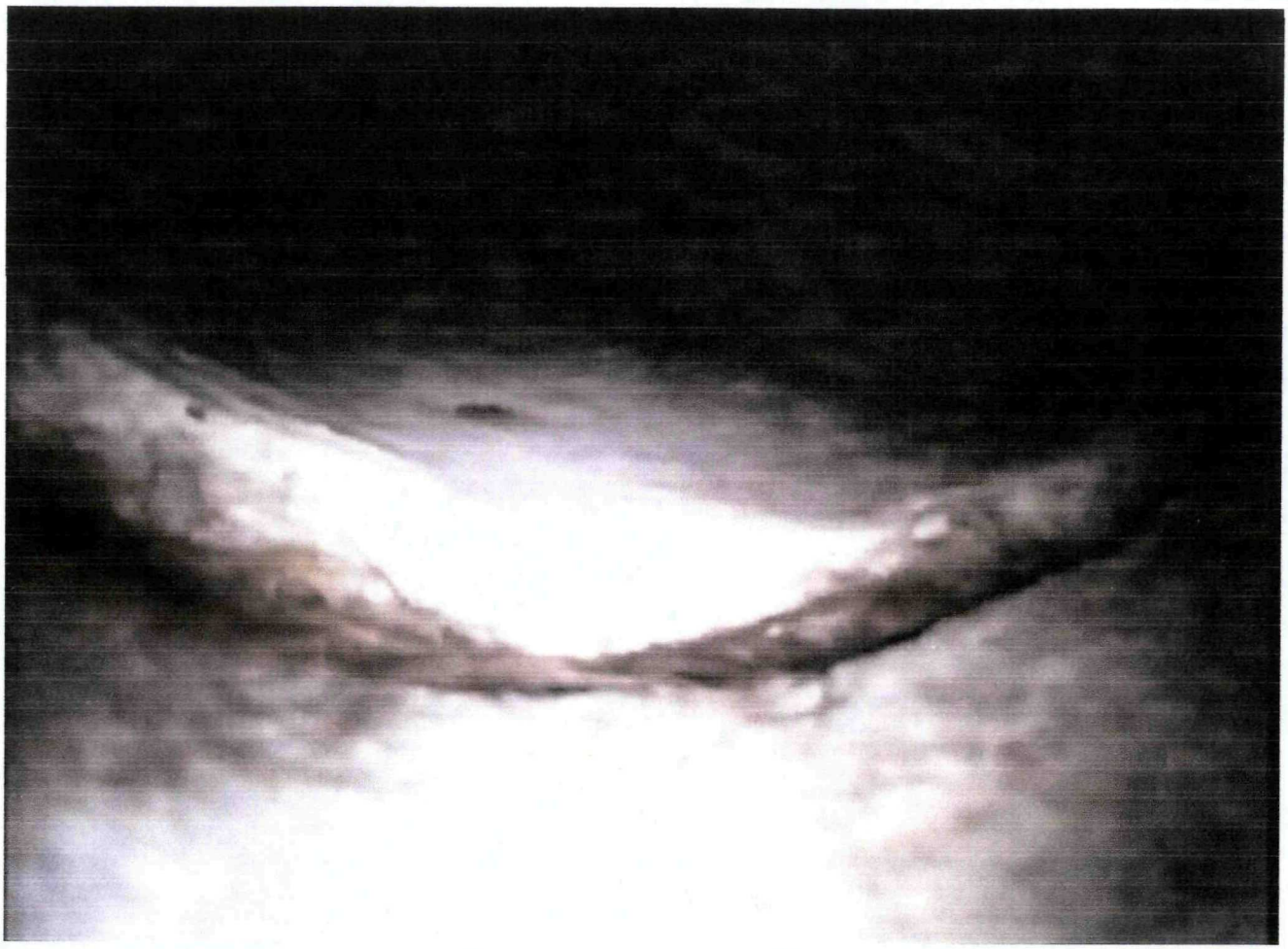


Drain 1: Pipe Joint Seperation

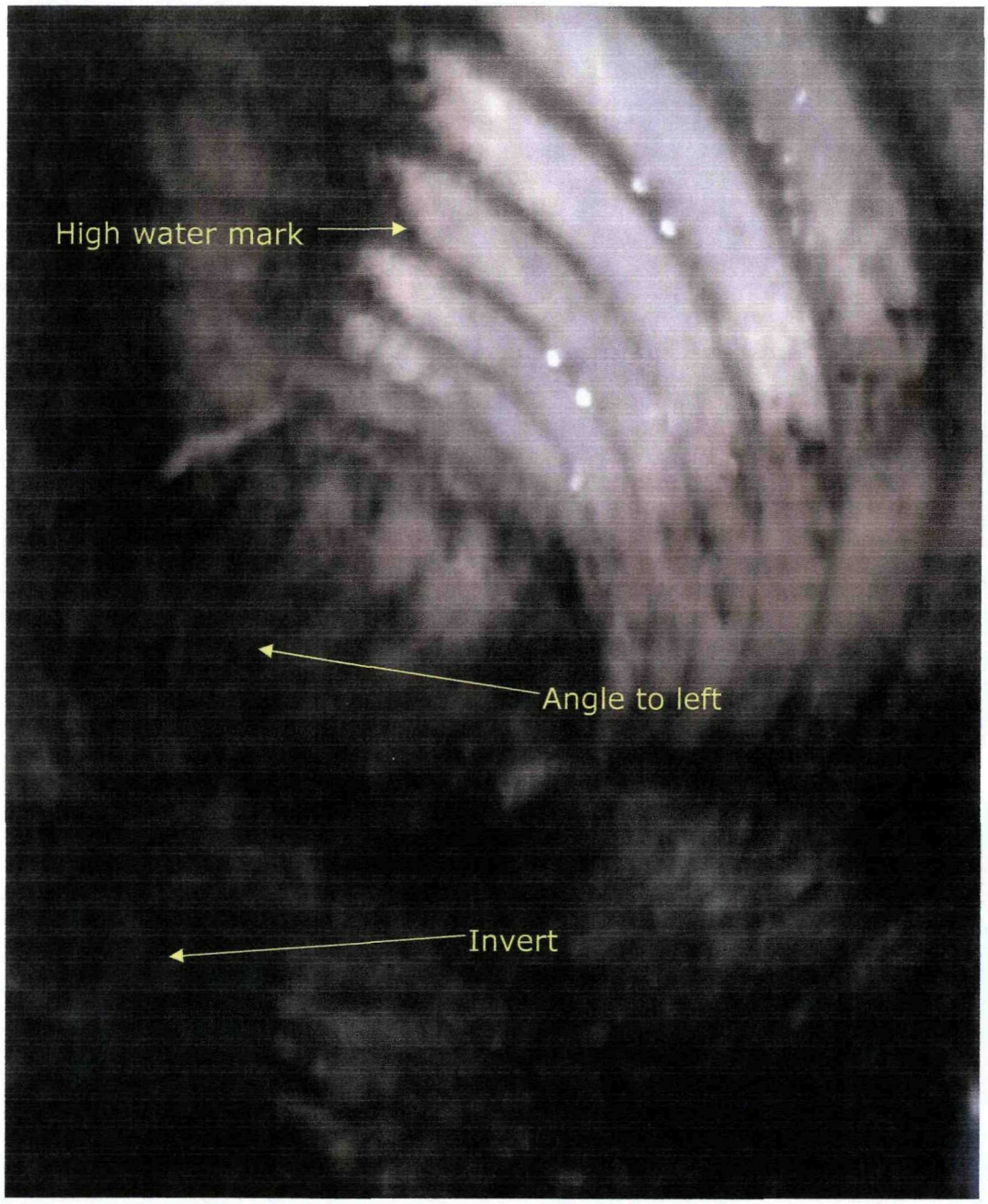
Drain 1: CMP to RCP location



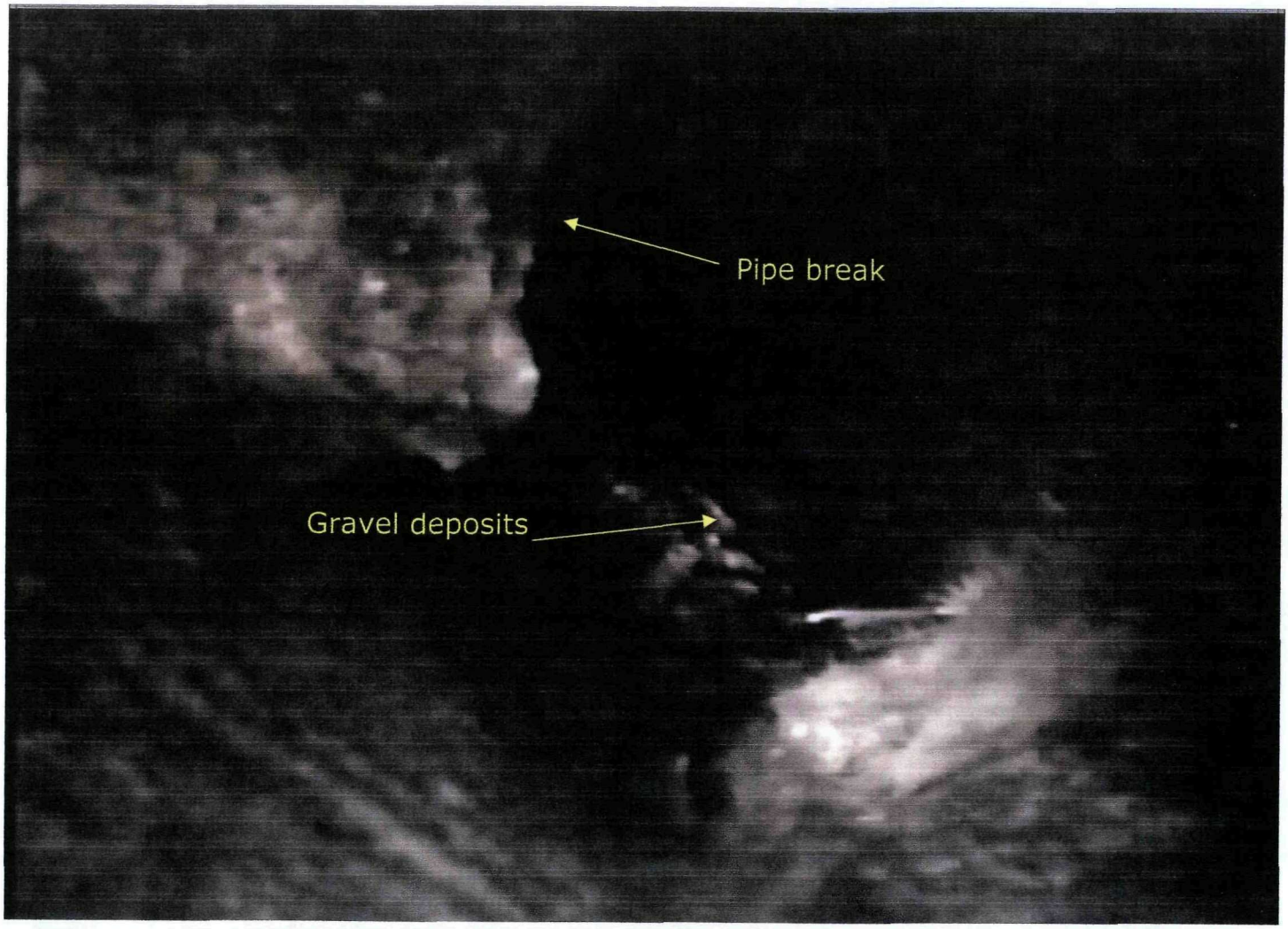
Drain 1: CMP to RCP at transition at top of pipe



Drain 1: Pipe joint separation

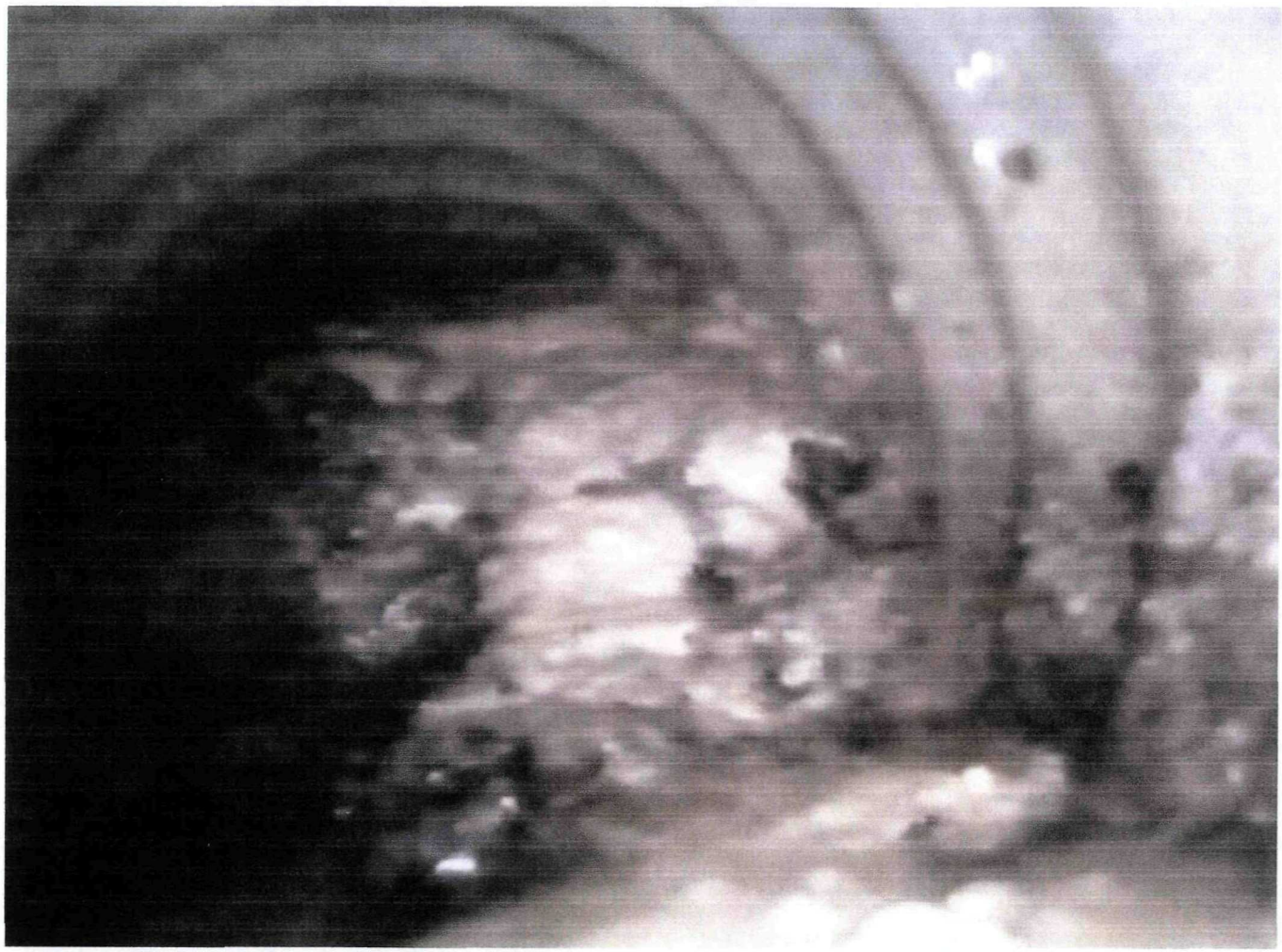


Drain 2: Angle to the left and high water mark

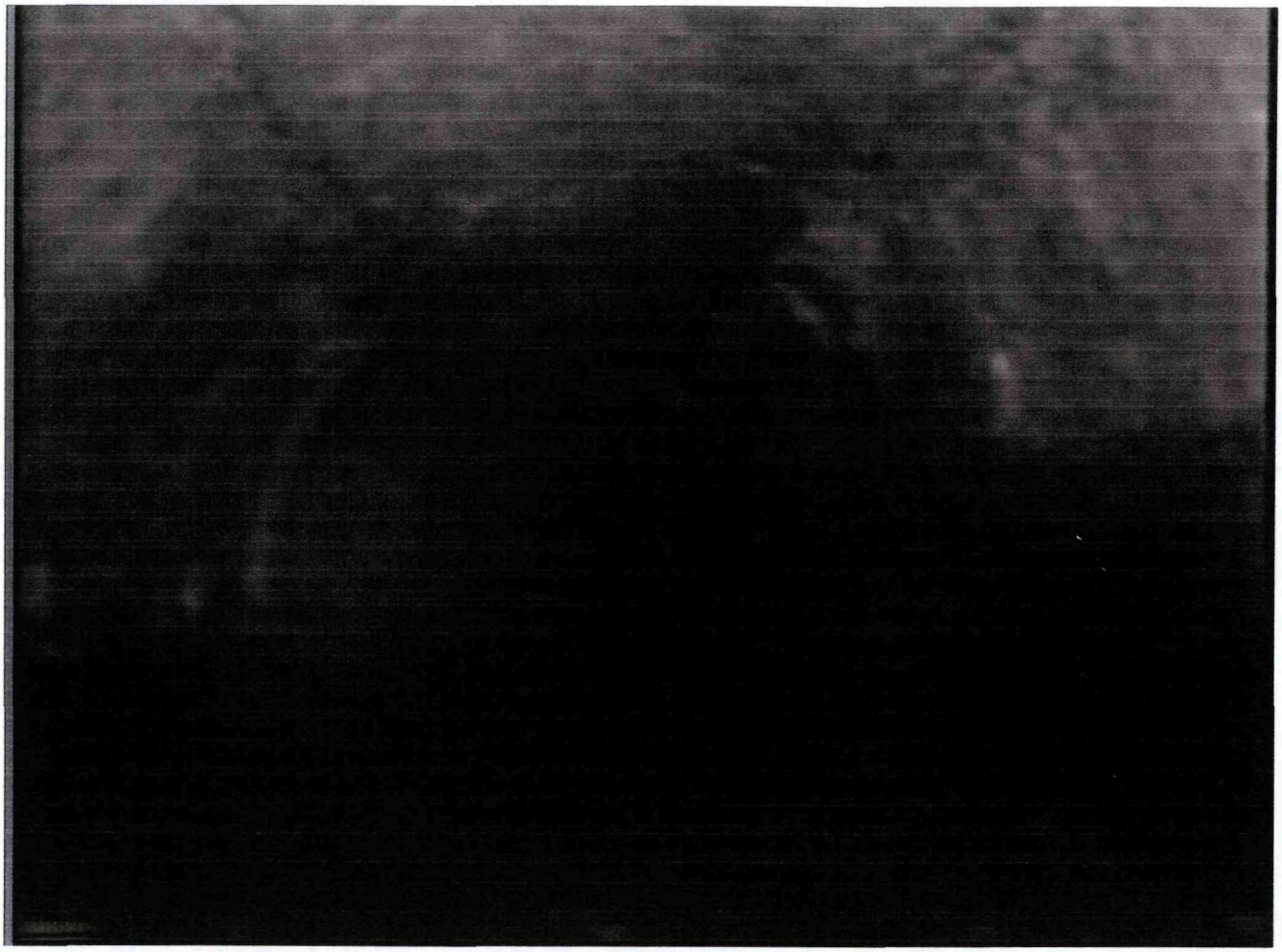


Drain 2: Break in pipe and gravel deposits

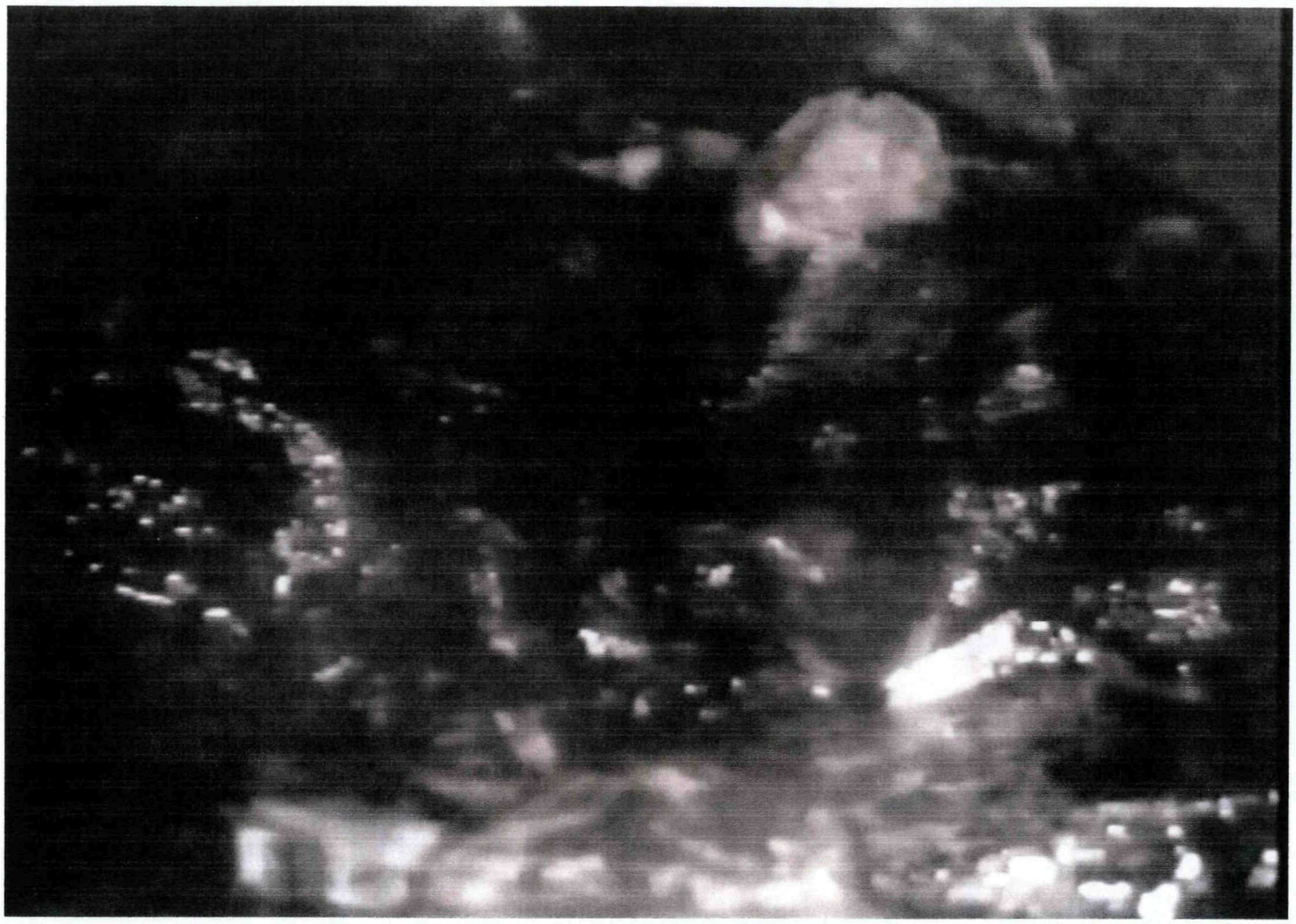
Drain 3: Concrete headwall



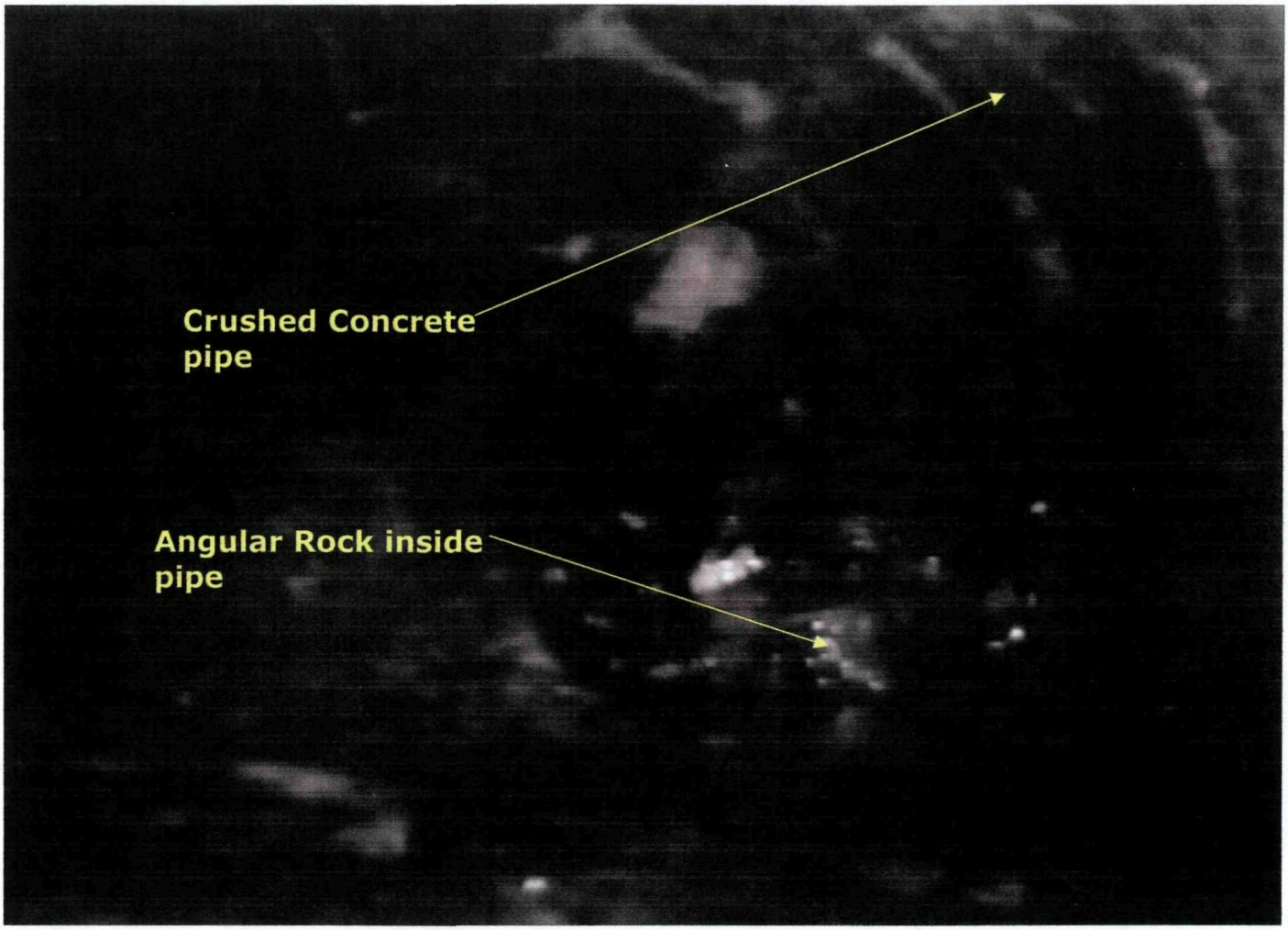
Drain 8: Silt or Clay deposit on rock deposits at the end of Drain 8



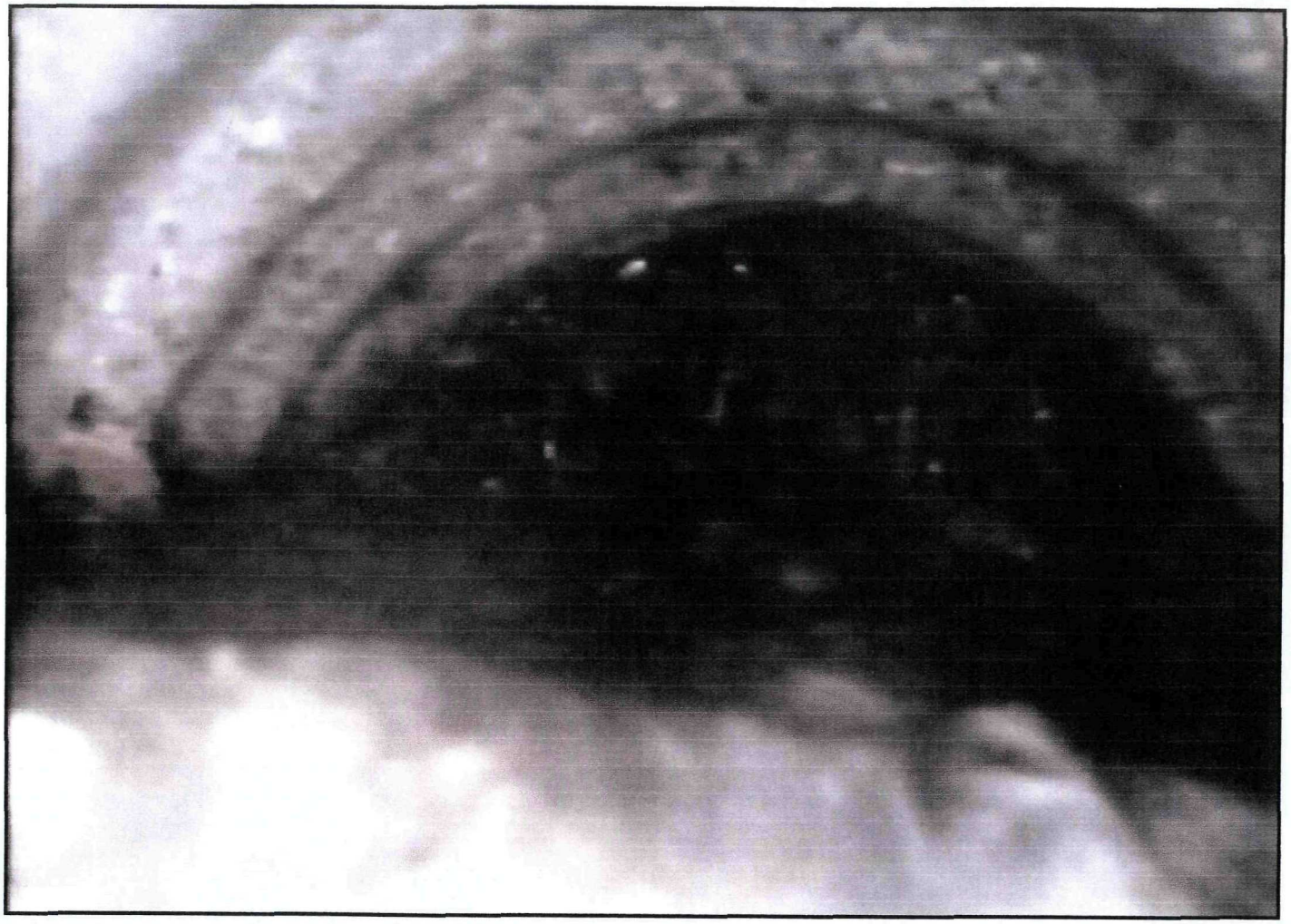
Drain 9: Pipe out of round, crush cracking on ceiling



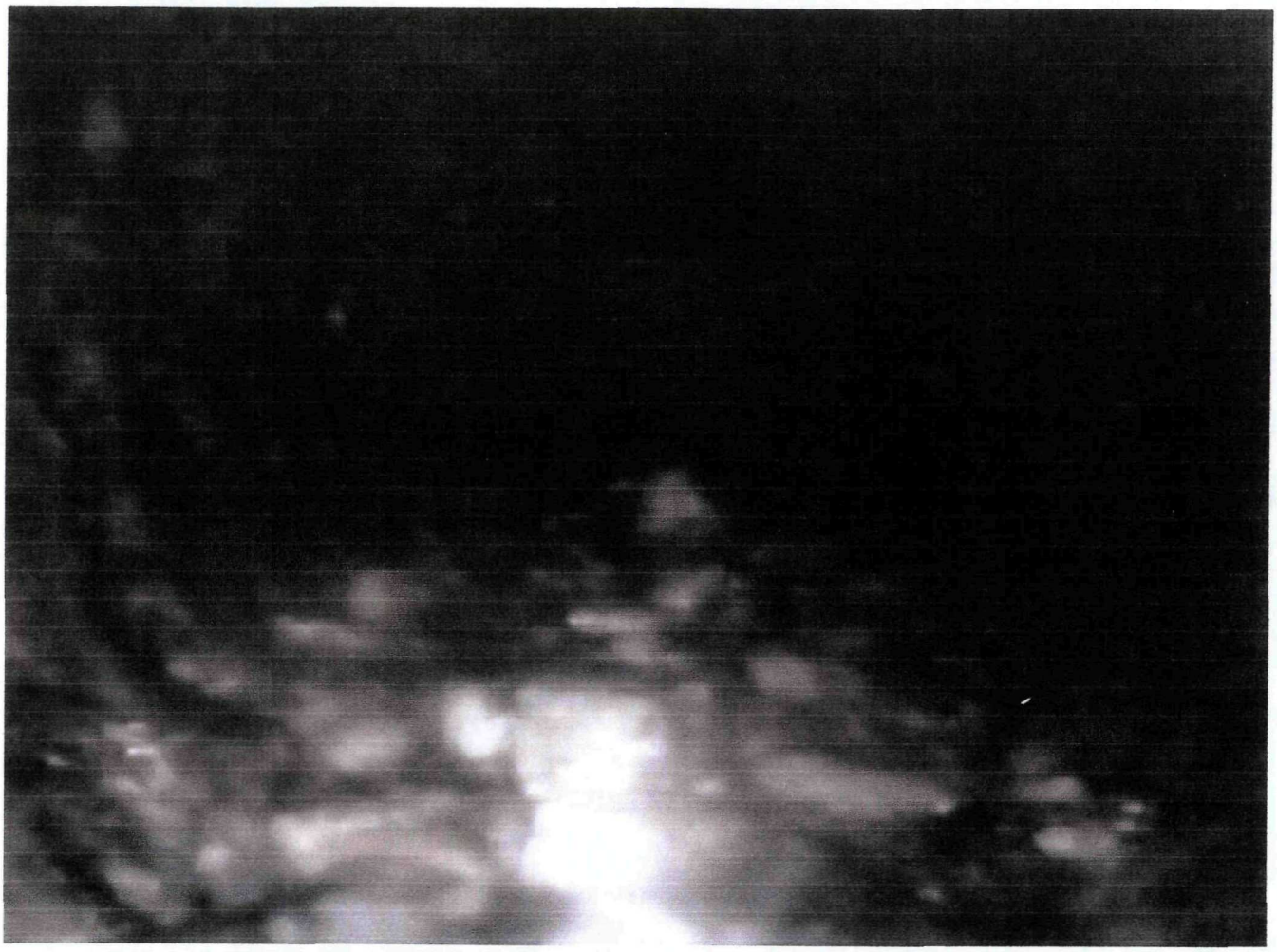
Drain 9: Angular Rock at the end of Drain 9



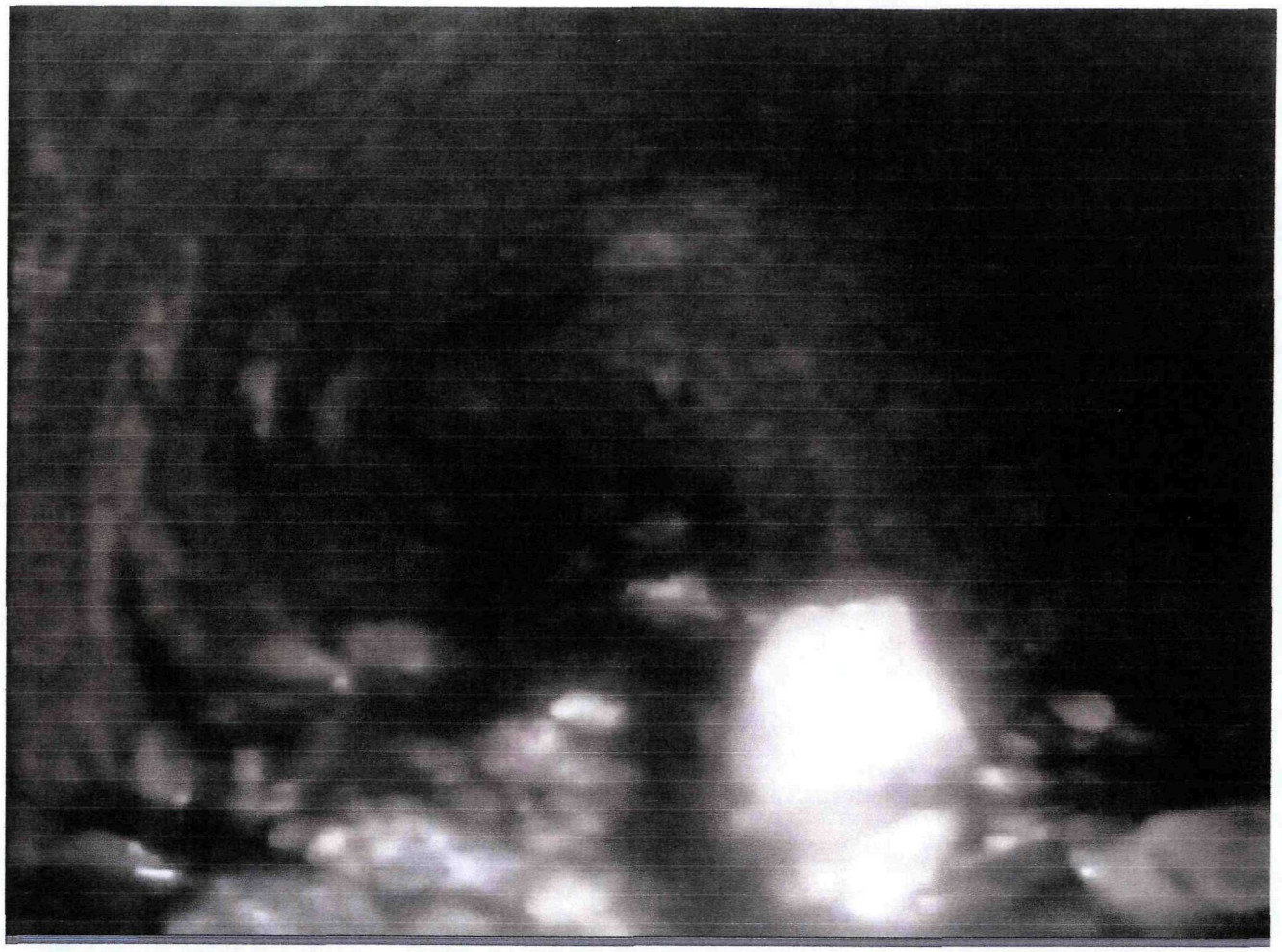
Drain 9: Angular rock and crushed concrete pipe at the end of Drain 9



Drain 10: Concrete headwall or bell end of pipe at end of 10-inch CMP drain

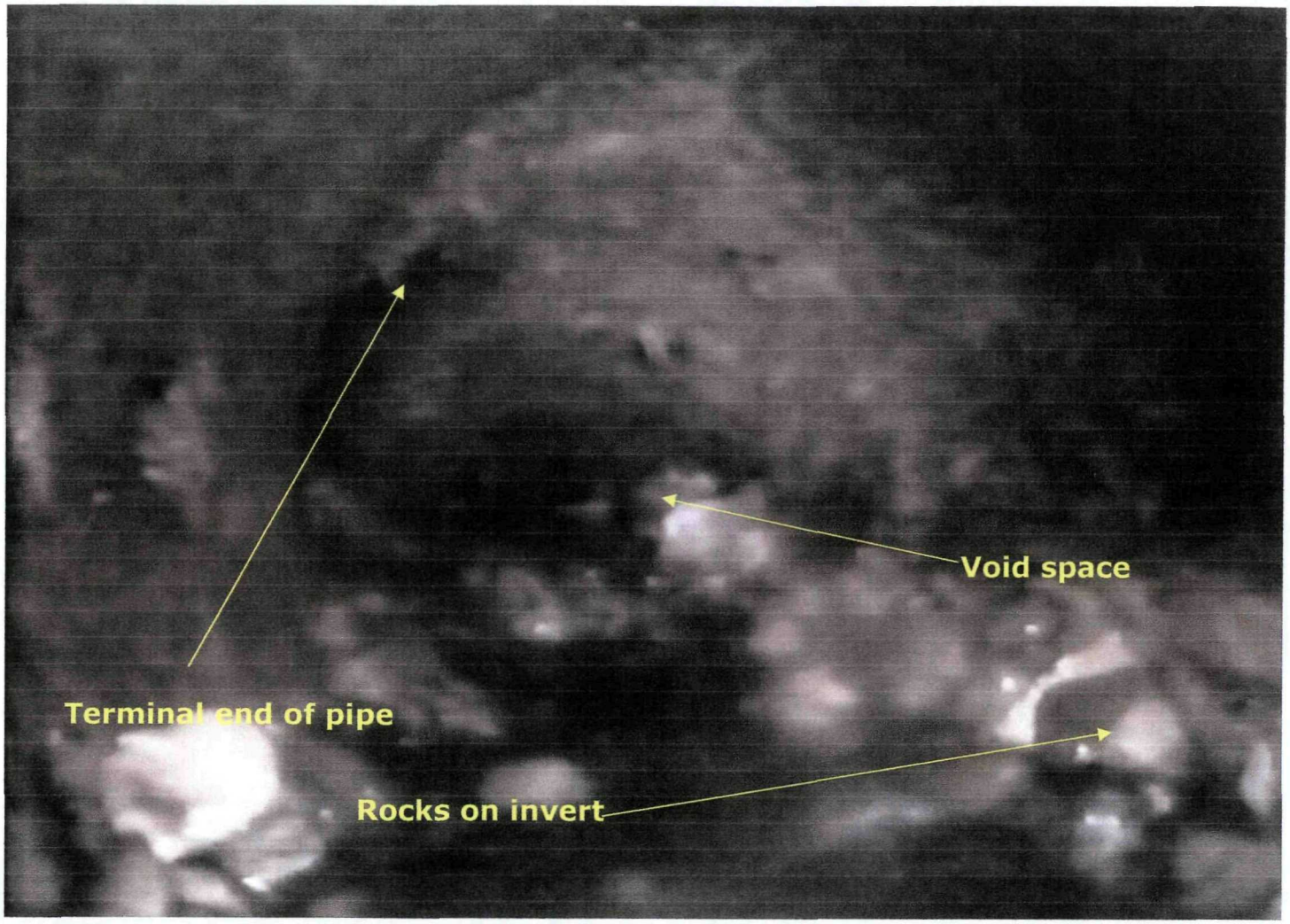


Drain 11: Rock deposits on the invert of Drain 11

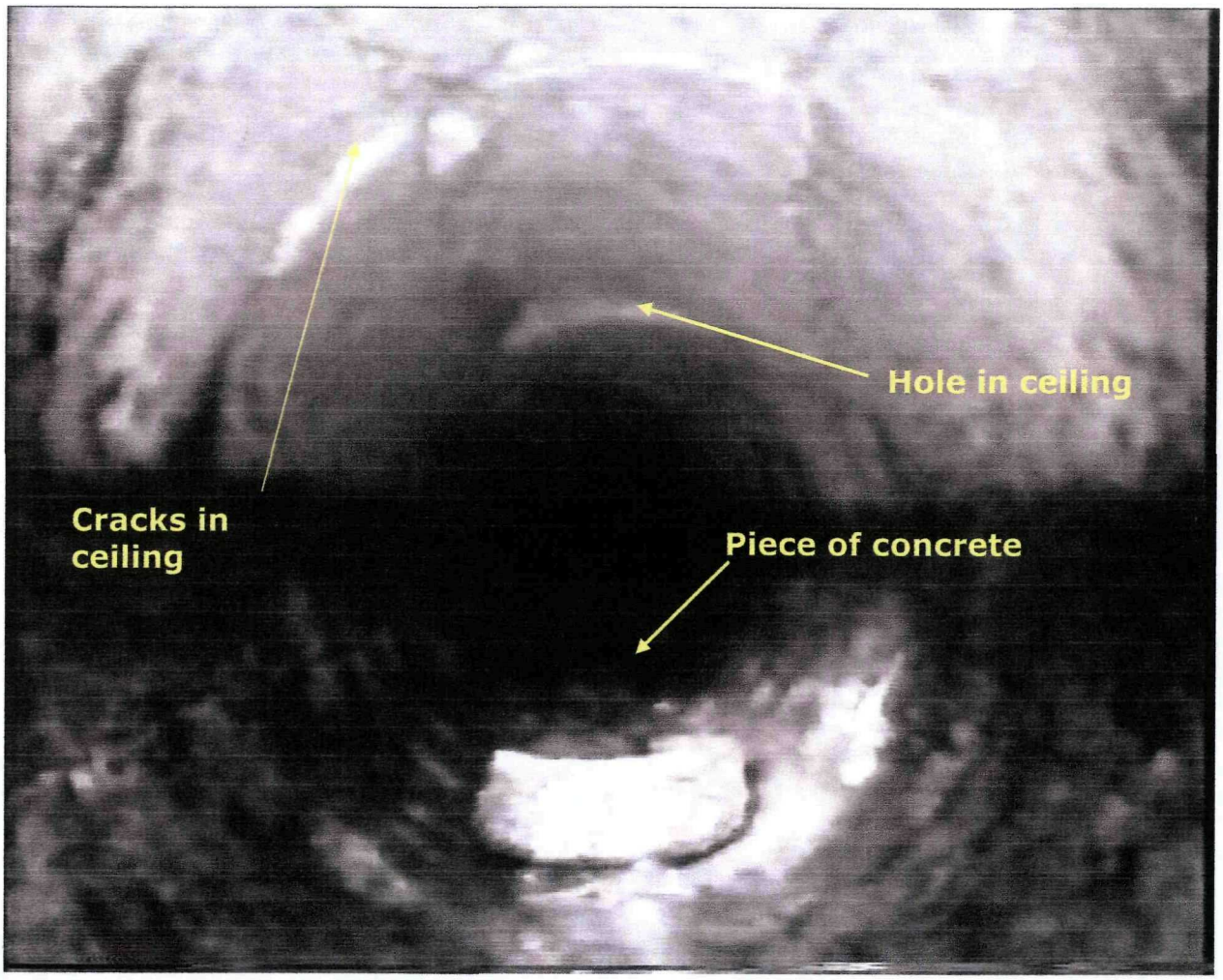


Drain 11: Larger Rocks at near the end of Drain 11

Drain 11: Large rocks and void space at the end of Drain 11



Drain 11: Terminal end of pipe, rocks on invert and void space at the end of Drain 11



Drain 12: Cracks in ceiling and concrete piece in pipe

APPENDIX B

DVD's

TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 1192621

SITE NAME: LIBBY ASBESTOS SITE

DOCUMENT DATE: 04/26/2010

DOCUMENT NOT SCANNED

Due to one of the following reasons:

- ☐ PHOTOGRAPHS
- ☐ 3-DIMENSIONAL
- ☐ OVERSIZED
- ☑ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
- ☐ POOR LEGIBILITY
- ☐ OTHER
- ☐ NOT AVAILABLE
- ☐ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

4 DVDs KDID TOE DRAIN INSPECTION MARCH 1, 2, and 3, 2010:
VOLUME 1 DRAIN 1 AND DRAIN 2
VOLUME 2 DRAINS 8-11 AND DRAIN 6
VOLUME 3 DRAINS 3-5 AND DRAIN 12
VOLUME 4 ALL DRAINS, VIDEO CONDENSED

Contact the Superfund Records Center to view available document.
(303) 312-6473

APPENDIX C

DRAIN LOCATION DRAWINGS

TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 1192621

SITE NAME: LIBBY ASBESTOS SITE

DOCUMENT DATE: 04/26/2010

DOCUMENT NOT SCANNED

Due to one of the following reasons:

☐ PHOTOGRAPHS

☐ 3-DIMENSIONAL

☑ OVERSIZED

☐ AUDIO/VISUAL

☐ PERMANENTLY BOUND DOCUMENTS

☐ POOR LEGIBILITY

☐ OTHER

☐ NOT AVAILABLE

☐ TYPES OF DOCUMENTS NOT TO BE SCANNED
(Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

DRAWING 1 OF 3 PHASE 5 ADDITION
DRAWING 2 OF 3 EXISTING DRAIN LAYOUT AND LENGTHS
DRAWING 3 OF 3 PHASE 5 & EXISTING DRAIN COMPARISON

Contact the Superfund Records Center to view available document.
(303) 312-6473

APPENDIX D

DRAIN LENGTH AND SURVEY DATA

KDID Toe Drain Depths
3/2/2010
Hafferman

Drain		Pipe Sections		Additional Length		Total Length	Location Comment
12		6		2		59.6	Debris (rocks and sand) stop camera form continung further into pipe. Appears that pipe may go further than debris. No water in pipe beyond 51 ft.
5		3		3		31.8	End terminates in rock, debris pile
4		1				9.6	End terminates in rock and debris
3		10		2		98	Continues on well beyond end of camera, total length unknown
11		1		3		12.6	End terminates in rock and debris
10		1		4		13.6	End terminates in rock and debris
9		4		5		43.4	End terminates in rock and debris
8		1		9		18.6	End terminates in rock and debris
6		10		2		98	Continues on well beyond end of camera, total length unknown. Camera underwater for most of the length of the inspection.

KDID Toe Overburden depth
3/2/2010
Hafferman

Drain	Top of PipeElevation	Invert Elevation	Terminal end Elevation on Embankment	Overburden Depth
D1	2792.61	INVERT = 2791.605 - 12" CMP	2795.86	3.25
D2	2791.18	INVERT = 2790.175 - 12" CMP	2794.43	3.25
D3	2791.11	INVERT = 2790.277- 10" RCP	UNKNOWN	
D4	2789.42	INVERT = 2788.748 - 8" RCP	2791.42	2.01
D5	2789.95	INVERT = 2789.953 - 12" CMP	2803.47	13.52
D6	2789.19	INVERT = 2788.102 - 13 " Steel	UNKNOWN	
D7	2790.71	INVERT = 2789.876 - 10" RCP	UNKNOWN	
D8	2787.55	INVERT = 2786.721 - 10" CMP	2792.75	5.20
D9	2788.18	INVERT = 2787.343 - 10" RCP	2805.45	17.27
D10	2787.76	INVERT = 2786.756 - 12" CMP	2790.15	2.39
D11	2788.45	INVERT = 2787.621 - 10" RCP	2790.55	2.10
D12	2790.11	INVERT = 2789.477 - 8" RCP	2809.47	19.36